Water Resource Report 53

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GROUNDWATER RESOURCES IN THE CUMBERLAND AND CONTIGUOUS VALLEYS OF FRANKLIN COUNTY, PENNSYLVANIA

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PREPARED IN COOPERATION WITH
U. S. GEOLOGICAL SURVEY

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Prepared by the United States Geological Survey, Water Resources Division, in cooperation with the Pennsylvania Geological Survey

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(in envelope)

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GROUNDWATER RESOURCES IN THE CUMBERLAND AND CONTIGUOUS VALLEYS OF FRANKLIN COUNTY, PENNSYLVANIA

by

Albert E. Becher[1] and Larry E. Taylor[2]

ABSTRACT

Increasing demands for water in the Cumberland Valley of Franklin County favor greater development of groundwater for public supplies and industrial use. Current use averages nearly 15 million gallons per day from all sources and for all purposes.

The aquifers are in a folded, faulted, and fractured sequence of carbonate rock, 14,000 feet thick, and shale, about 3,000 feet thick. Carbonate rock underlies about 55 percent of the area, the remainder being shale. The largest carbonate area is on the east side of the valley; several smaller areas, separated by shale terrane, occur to the west. A few hundred feet of colluvium masks the older rocks of the sequence along South Mountain on the eastern boundary of the valley.

The Potomac River basin drains most of the area through Antietam and Conococheague Creeks. The northeast and northwest corners are drained by the Susquehanna River through Conodoguinet Creek.

Evapotranspiration consumes about 55 percent of the average precipitation of 42 inches. Groundwater contributes about 80 percent of the flow of Antietam Creek (largely in colluvial and carbonate terrane) and about 70 percent of the flow of Conococheague Creek (35 percent carbonate terrane). Carbonate rocks yield from 0.75 to 0.85 million gallons per day per square mile, and shale yields about 0.48 million gallons per day per square mile.

The hydrologic system is strongly influenced by the geology. Location and flow characteristics of streams, groundwater recharge rates, and directions of groundwater and surface-water movement are largely dependent on the areal distribution of rock types and structure.

The median sustained yields of single wells in formations of the carbonate-rock aquifer, in gallons per minute, calculated from specific-capacity data, are: Tomstown, 34; Waynesboro, 42; Elbrook, 45; Zullinger, 40; Shadygrove, 68; Stonehenge, 138; Rockdale Run, 32; Pinesburg Station, 46; St. Paul Group, 15; and Chambersburg, 11. Calculated median sus-

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tained yields are 29 and 50 gallons per minute from the shale and graywacke sandstone, respectively, of the Martinsburg Formation.

Median depths of wells are 88 feet in the Martinsburg and 143 feet in the carbonate aquifer. Only 17 percent of yield zones occur at depths greater than 100 feet in wells of the Martinsburg as compared to 51 percent in wells of the carbonate aquifer.

Wells commonly show a greater drawdown response along the strike (the trend of tilted beds) from a pumping center than across strike. Data on the orientation of passages in limestone caves of the valley indicate that solution passages develop preferentially in bedding and in joints parallel to the strike of bedding. These openings probably control the anisotropic pumping effects in limestone. Cleavage and strike-oriented joints probably are the cause of similar effects in the Martinsburg.

Wells drilled in low topographic positions have significantly greater yields than wells at other sites. Yields from valley wells in shale and limestone are 3 and 20 times greater, respectively, than those on hilltops. Of 20 wells drilled on fracture traces, five are among the highest yielding in the southern Cumberland Valley of Pennsylvania. An equal number, however, do not produce even a domestic supply.

Estimates of transmissivity range from 150 to 800 square feet per day for the Martinsburg aquifer, and from 120 to 4,000 square feet per day for the carbonate aquifer. The average storage values are about 0.005 in the Martinsburg aquifer and 0.04 in the carbonate aquifer. Interference between pumping wells can be substantial, based on these hydraulic parameters, in wells spaced less than 500 feet apart. Under anisotropic conditions, interference between wells spaced 1,000 feet apart may be significant if pumping is sustained for long periods at high rates.

Water quality is generally good. High iron (median 0.77 milligram per liter) and manganese (median 0.33 milligram per liter) concentrations in water from wells in the Martinsburg are common. Water in the carbonate aquifer is hard to very hard. A median nitrate concentration of 6.8 milligrams per liter for samples taken since 1970 of water from the carbonate aquifer indicates widespread chemical contamination. The carbonate aquifer is vulnerable to bacterial and chemical contamination because of the rapid rates of infiltration.

Problems involving groundwater include flooding in areas of shallow water levels, bacterial and chemical contamination of the carbonate aquifer, and low well yields locally.

INTRODUCTION

This is an appraisal report of the groundwater resources of shale and carbonate rock in the southern part of the Cumberland Valley, Pennsylvania,

and several smaller contiguous valleys to the west (Figure 1). The report describes the hydrologic system, evaluates the yield potential of the rocks, discusses the criteria important to well site selection, and describes the quality of the groundwater. The study was undertaken by the U. S. Geological Survey in cooperation with the Pennsylvania Topographic and Geologic Survey to provide information about alternatives to surface supplies of water. The information can aid planning organizations, municipalities, rural communities, consulting geologists, engineers, well drilling firms, and industry in their efforts to efficiently develop existing water and land resources. Individuals interested in drilling wells for home or farm use can benefit by utilizing the information to select favorable drilling sites, estimate optimum drilling depths, compute costs, estimate yield potential, and anticipate development problems.

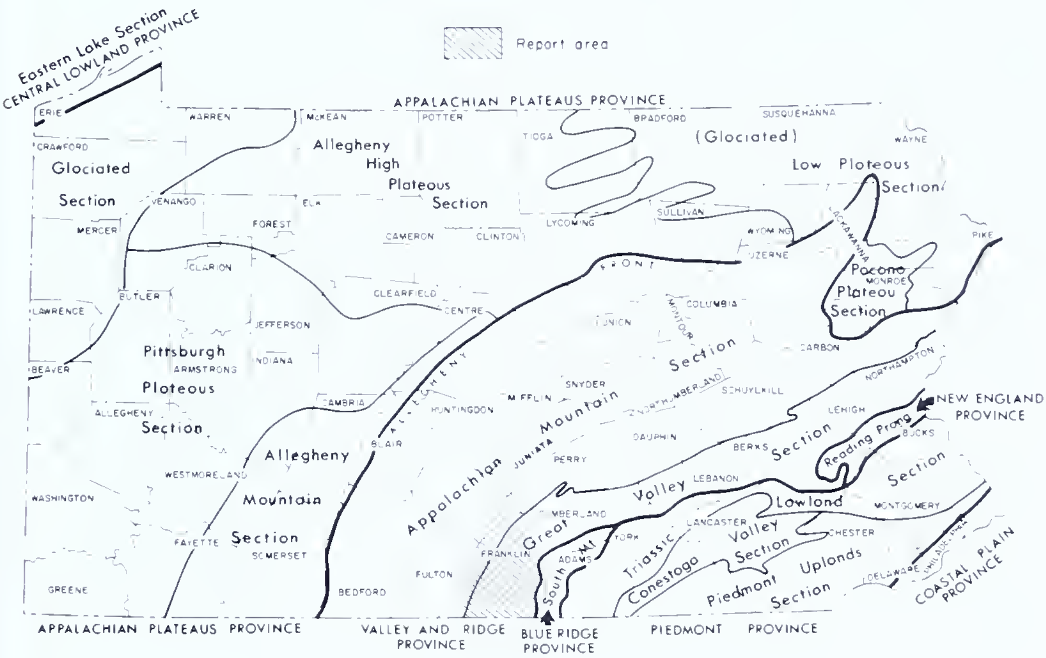

Figure 1. Map of Pennsylvania showing the physiographic provinces and the location of the study area.

WATER USE

Water use in the area over the past 10 years has increased about 15 percent, exclusive of irrigation. The latter use depends on weather conditions and varies greatly from year to year. State planning projections indicate continued growth in demand for water, and groundwater development is

recommended to meet the demand in many areas of the southern part of the Cumberland Valley.

Water withdrawn from groundwater sources and streams for use in 1978 averaged 14.6 Mgal/d (million gallons per day) based on Commonwealth of Pennsylvania, Department of Environmental Resources data. Groundwater supplied 44 percent of this amount. The percentage of the total for each use category and the percentage obtained from each source to supply that use are shown in Figure 2. Public supply systems account for more than half of the total use and surface-water sources supply the bulk of this water (Pennsylvania Department of Environmental Resources, 1979, p. 34-37). The largest public suppliers from surface-water sources are the Boroughs of Chambersburg and Waynesboro, and the largest from groundwater sources are Greencastle and Mercersburg. Private homes and farms account for about one third of total use (U. S. Department of Commerce, Bureau of the Census, 1971). More than half of the population depends on groundwater for personal supplies. Industrial use from groundwater has tripled in 10 years.

DATA BASE

The geologic map shown on Plate 1 is a compilation of work done since 1968 by Root (1968, 1971, and unpublished), Clark (1970), Fauth (1968), and Okuma (1970). Records of 710 wells and 19 springs, compiled from drillers' reports and field measurements, are given in Tables 13 and 14, respectively. Single-well pumping tests of 1-hour duration on 103 wells and aquifer tests of longer duration on four well fields were performed by project personnel. Additional specific-capacity data for varying periods of pumping were calculated from selected drillers' reports for 210 wells. Continuous records of water levels were obtained on eight wells for periods ranging from 1 to 3 years. A continuous-record stream gage station and a monthly-measurement network of 30 wells were maintained on the Back Creek basin for a period of 2 years. Thirty-nine chemical analyses of water from samples taken by the U. S. Geological Survey or private organizations are given in Table 10. Borehole geophysical data, aerial photographs, and other public and private reports and records were also helpful to the study.

ACKNOWLEDGEMENTS

We gratefully acknowledge the cooperation and help of the many homeowners, organizations, and company officials and their staffs who kindly allowed us access to their property for the collection of the data essential to this study. Special thanks are due to Mr. Edward C. Bittner of the Greencastle Borough Authority for allowing continuous access to the borough wells and springs during several years of data collection, and to Mr. David Singer and the engineering staff of Grove Manufacturing, the management

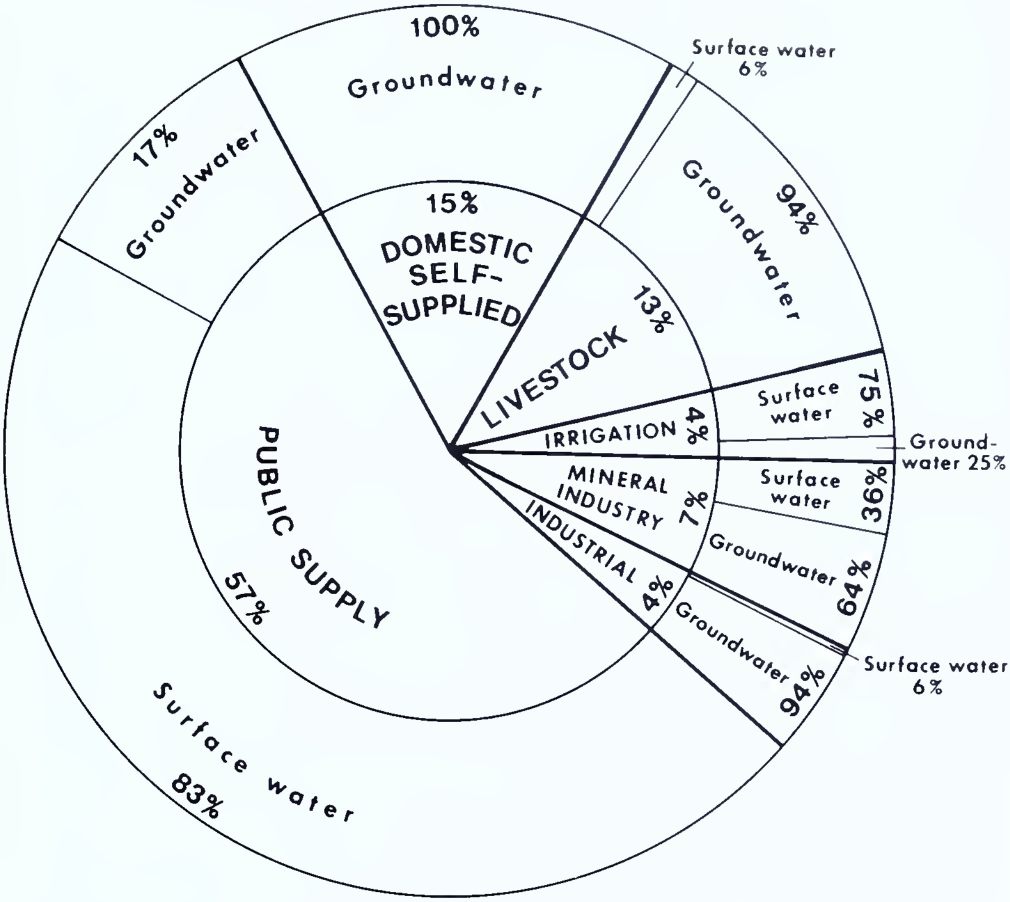

Figure 2. Water use in the major valleys of Franklin County. Inner circle represents percent of total use of each category; outer circle represents percent from each source by each category.

and staff of Anvil products, Mr. Michael Hare of Penn National Estates, and Mr. Paul Bert for assistance during pumping tests on their well fields. Also, thanks are due to Valley Quarries, who allowed access and provided assistance for test drilling at the Mt. Cydonia gravel quarry. Our thanks are also extended to Dr. Samuel I. Root, who, while a member of the Pennsylvania Geological Survey, provided his professional insight to our understanding of the geology, and completed the geologic mapping in the Shippensburg and Roxbury quadrangles essential for compilation of the base map.

GEOHYDROLOGY

GEOLOGIC SETTING

The Cumberland Valley and the several contiguous small valleys to the northwest developed on a folded sequence of Cambrian and Ordovician

limestone that contains minor amounts of dolomite, and on Ordovician shale that contains subordinate amounts of graywacke (Figure 3). These rocks were formed about 500 million years ago and constitute a continuous depositional sequence of limestone, about 14,000 feet thick, and shale, about 3,000 feet thick. Bounding the valleys are steep forested ridges of resistant quartzite in South Mountain on the east and quartzitic sandstone in several mountain ridges on the west. Deformation of the rock sequence about 200 million years ago and erosion to the present time have produced the existing landscape and complex geologic pattern shown on Plate 1.

The central structural feature in the valley is a syncline (down fold) that has its axis in the shale belt just west of Chambersburg and Greencastle

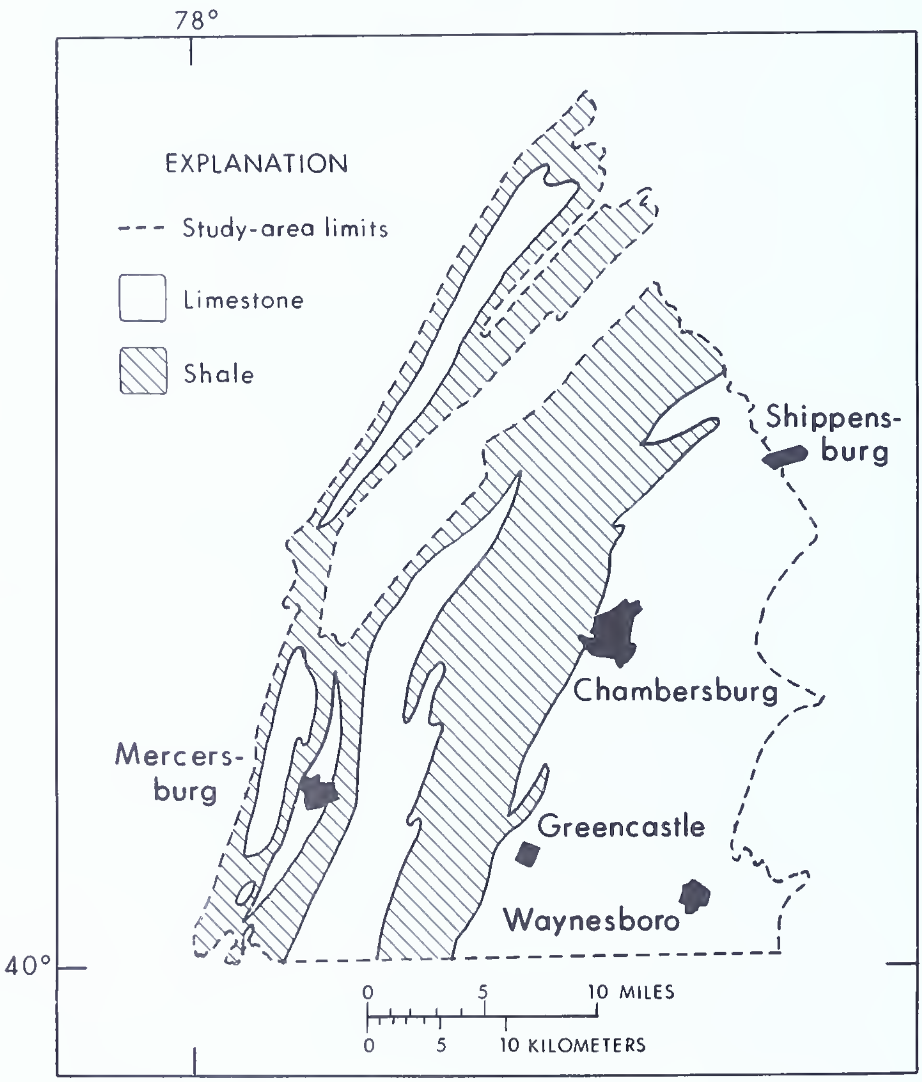

Figure 3. Geographic distribution of limestone and shale in the study area.

(Figure 3). A series of small anticlinal folds (up folds) dominate the structure of the major limestone belt east of the central shale belt. Several small anticlines occur in smaller limestone belts bordered by shale to the west of the central belt of shale. Many of the contacts between limestone and shale are formed by faults that trend parallel to the northeast structural grain of the region and dip steeply to the southeast. Most folds are disrupted by faults that also trend subparallel to the regional structure, although small cross-cutting faults are common. Detailed discussions of the structure and stratigraphy can be found in reports listed in the references, especially Root (1968, 1970, 1971, and 1973), Clark (1970), and Okuma (1970). Table 1 gives a brief description of the rock units in descending order from youngest to oldest.

HYDROLOGIC SYSTEM

Water enters the hydrologic system as precipitation or streamflow and leaves as water vapor in the atmosphere (evapotranspiration), overland flow, or groundwater discharge to streams (Figure 4). Most of the water entering the system moves out of the Franklin County area within 3 or 4 days, based on the rule of thumb in Linsley and others (1958, p. 156). Except for a small amount held in surface bodies, water that remains for longer periods has percolated underground and eventually is discharged to streams of the Antietam, Conodoguinet, or Conococheague Creek basins. The Conodoguinet drains both the northeast and northwest corners of the area and flows north into the Susquehanna River. Antietam Creek drains the southeast corner, and Conococheague Creek drains the remaining two thirds of the area; both flow into the Potomac River.

Groundwater has a significant role in the system, as almost one third of the precipitation infiltrates the land surface and slowly moves down gradient from areas of recharge. Eventually, groundwater returns to the land surface and is discharged to streams through many small seeps or large springs such as Sp-18 shown in Figure 5. The average annual recharge (or discharge) is a rough estimate of the maximum groundwater available for consumptive use. Groundwater use in excess of average recharge will progressively lower groundwater levels and reduce the average flow of streams. Although consumptive use of this magnitude will reduce flow and may dry up streams, the timing of withdrawals and increased recharge induced by lowering of groundwater levels may substantially alter these adverse effects.

Water Budgets

The value of each component in the hydrologic system must be quantified to determine the amount of groundwater available for use. A water budget is the quantitative expression of major components of the hydrologic system. It balances water that enters a groundwater basin as precipitation with

Table 1. *Description and Water-Bearing Characteristics of the Geologic Units*

System	Geologic unit	Thickness (feet)	Character of rocks	Water-bearing characteristics
Quaternary	Colluvium	0-250	Mixture of clay, silt, sand, pebbles, cobbles, and boulders overlying a thick residual clay layer.	Yields domestic supplies commonly at the contact with bedrock. Provides extra storage for underlying limestone. Maximum reported yield is 30 gal/min from stream sand and gravel. Calculated maximum sustained yield is 110 gal/min.
Ordovician	Martinsburg Formation	1,500-3,000	Thin basal unit of platy limestone; thick medial unit of graywacke; bulk of formation is black carbonaceous and fissile shale. Formation is thinner to west.	Good aquifer. Maximum reported yields are 150 gal/min from shale and 50 gal/min from graywacke. Calculated maximum sustained yield is 100 gal/min for shale and graywacke. No data are available for basal limestone. Only 3 percent of wells need standby storage for minimum domestic supply.
	Chambersburg Formation	300-750	Dark-gray, thin-bedded limestone that characteristically weathers into cobblestone shapes. Thinner to west.	Poor aquifer. Maximum reported yield is 40 gal/min. Calculated maximum sustained yield is 35 gal/min. About 25 percent of wells require standby storage to meet minimum domestic needs.
	St. Paul Group	800-1,000	Light-gray limestone; minor interbeds of dolomite containing black chert. Thinner to west. Abundantly fossiliferous.	Fair aquifer. Maximum reported yield is 225 gal/min. Calculated maximum sustained yield is 160 gal/min. About 30 percent of wells require standby storage to supply minimum domestic needs.
	Pinesburg Station Formation	250-800	Medium-gray dolomite; some interbeds of limestone. Black chert and white quartz	Fair aquifer. Maximum reported yield is 30 gal/min. Calculated maximum sustained

			rosettes are present near base. Thicker to west.	yield is 150 gal/min. About 25 percent of wells require standby storage to supply minimum domestic needs.
	Rockdale Run Formation	2,200-3,000	Medium-gray limestone forms bulk of unit; some thick dolomite containing small white chert rosettes is present near top. East of Greencastle, lower part is light-gray limestone containing nodules of brown chert. Thinner to west; west of Greencastle, lower part contains abundant chert-bearing dolomite and banded limestone.	Good aquifer. Maximum reported yield is 410 gal/min. Calculated maximum sustained yield is 220 gal/min. About 25 percent of wells require standby storage to supply minimum domestic needs. Twelve public supply wells yield from this unit.
	Stonehenge Formation	775-1,000	Medium-gray limestone; abundant algal limestone in upper half. Thicker to west.	Very good aquifer of small areal extent. Maximum reported yield is 80 gal/min. Calculated maximum sustained yield is 500 gal/min. No wells in sample were unable to supply domestic needs.
	Stoufferstown Formation	260	Medium-gray, thin-bedded conglomeratic limestone containing prominent siliceous seams. Thinner to west and included in Stonehenge Formation on map.	Insufficient data. Occupies small amount of area. One public supply well sustains a yield of 350 gal/min for several weeks.
Cambrian	Shadygrove Formation	750	Thick-bedded, light-gray limestone containing brown chert nodules and a few thin beds of sandstone and dolomite.	Good aquifer. Maximum reported yield is 50 gal/min. Calculated maximum sustained yield is 240 gal/min. About 20 percent of wells require standby storage to supply minimum domestic needs.
	Zullinger Formation	3,000	Cyclical sequence containing medium-gray limestone, limestone conglomerate, dolomitic limestone, banded limestone and dolomite, dolomite, and sandy limestone.	Good aquifer. Maximum reported yield is 120 gal/min. Calculated maximum sustained yield is 390 gal/min. About 15 percent of wells require standby storage to supply minimum domestic needs.

Table 1. *(Continued)*

System	Geologic unit	Thickness (feet)	Character of rocks	Water-bearing characteristics
Cambrian	Elbrook Formation	3,000	Massive beds of shaly limestone, calcareous shale, some algal limestone, and minor amounts of calcareous sandstone.	Good aquifer. Maximum reported yield is 250 gal/min. About 15 percent of wells require standby storage to supply minimum domestic needs.
	Waynesboro Formation	1,000	Poorly exposed, massive, gray limestone forms bulk of unit; abundant dolomite is present in lower 300 feet. Upper 100 feet is red sandy shale, siltstone, and sandstone.	Good aquifer. Maximum reported yield is 200 gal/min. Calculated maximum sustained yield is 260 gal/min. Only 8 percent of wells require standby storage to supply minimum domestic needs.
	Tomstown Formation	1,000	Few exposures. Probably contains a basal part of limestone, dolomite, and interbedded shale; a middle part of dolomite; and an upper part of banded limestone and thin beds of dolomite. Covered by colluvium in most areas.	Fair aquifer. Maximum reported yield is 134 gal/min. Calculated maximum sustained yield is 105 gal/min. Only 11 percent of wells require standby storage to supply minimum domestic needs. Probably not tested to sufficient depths.

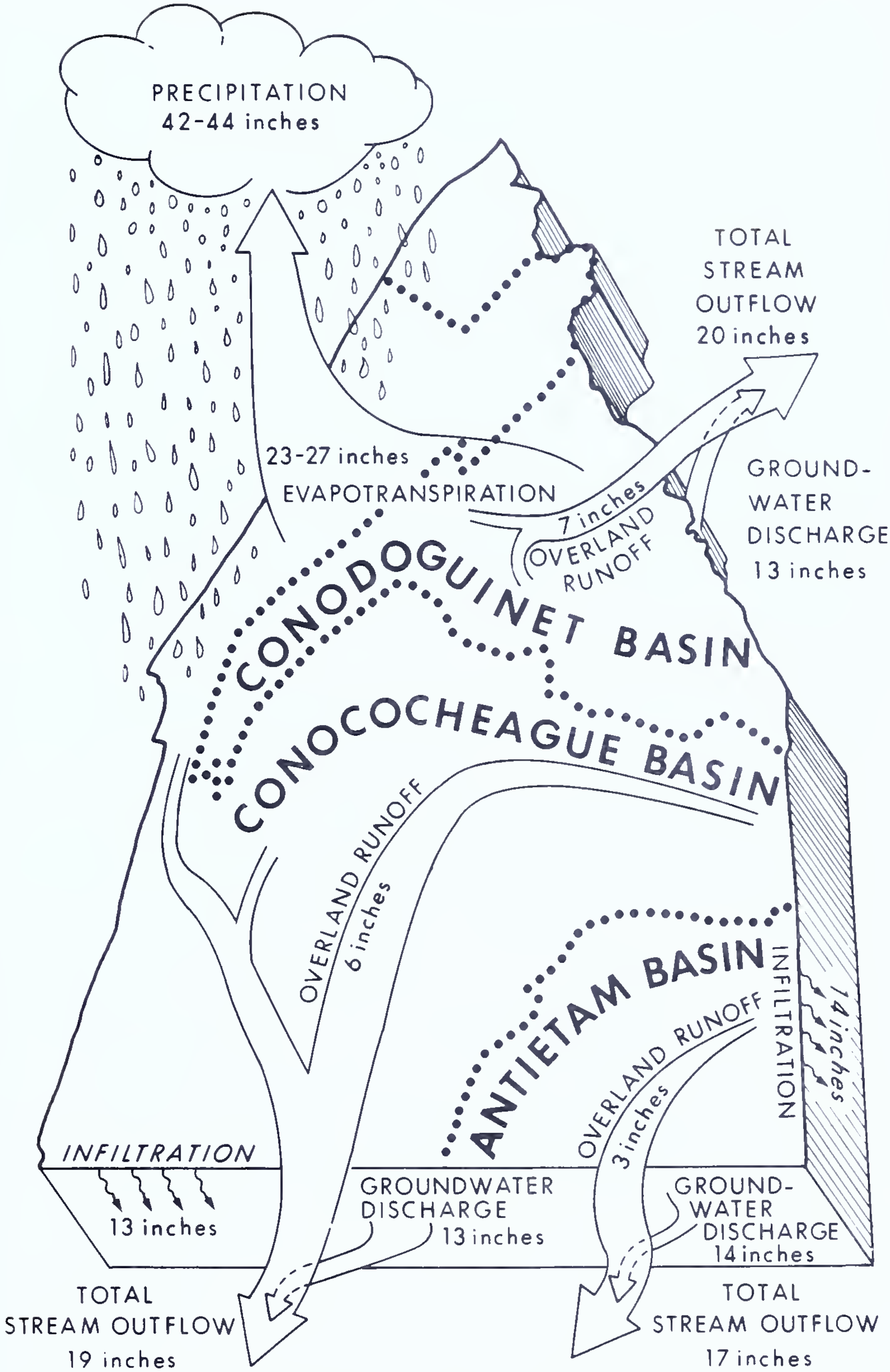

Figure 4. Annual circulation of water through the hydrologic system in Franklin County.

Figure 5. Part of the flow discharge from Nunnery Springs (Sp-18) on March 5, 1980. Discharge varies little throughout the year. The water is used for irrigation of orchards.

water that leaves as streamflow or evapotranspiration and changes in storage. A simple equation expressing this balance is:

$$P = R_g + R_s + ET + \Delta S$$

where

P = precipitation,

$(R_s + R_g)$ = total streamflow,

R_g = groundwater discharge,

R_s = surface runoff,

ET = water lost by evaporation and transpiration, and

ΔS = change in groundwater storage.

Average annual water budgets were determined for the Conococheague, Antietam, and Back Creek basins (Table 2). The Back Creek basin, although part of the Conococheague basin, was studied separately to provide groundwater data for terrane underlain by the Martinsburg Formation. The Conodoguinet Creek basin, with headwaters in the northern part of the area, was analyzed by Becher (Becher and Root, 1981) in a study of the groundwater resources of the northern Cumberland Valley. Figure 4 shows diagrammatically the hydrologic system in Franklin County, and gives the

Table 2. *Water Budgets for Major Stream Basins*

Water year	Precipitation P (inches)	=	Surface runoff R_s (inches)	+	Groundwater discharge R_g (inches)	+	Evapotranspiration ET (inches)
			BACK CREEK				
[1]1977	31.80	=	3.78	+	7.63	+	20.39
[1]1978	42.18	=	9.65	+	14.93	+	17.60
2-year average	36.99	=	6.72	+	11.28	+	19.00
Percent of total	100	=	18	+	31	+	51
			ANTIETAM CREEK				
1966	33.67	=	1.41	+	5.86	+	26.40
1967	42.86	=	2.03	+	11.44	+	29.39
1968	39.94	=	2.01	+	13.28	+	24.65
1969	34.40	=	.99	+	7.05	+	26.36
1970	49.71	=	2.58	+	13.71	+	33.42
1971	43.81	=	2.19	+	15.01	+	26.61
1972	48.44	=	5.07	+	19.55	+	23.82
1973	54.80	=	3.50	+	18.62	+	32.68
1974	43.60	=	2.71	+	14.98	+	25.91
1975	55.91	=	7.16	+	18.07	+	30.68
1976	39.60	=	2.40	+	16.43	+	20.77
1977	40.05	=	2.71	+	13.66	+	23.68
1978	46.08	=	3.07	+	15.50	+	27.51
13-year average	44.07	=	2.91	+	14.09	+	27.07
Percent of total	100	=	7	+	32	+	61

Table 2. *(Continued)*

Water year	Precipitation P (inches)	=	Surface runoff R_s (inches)	+	Groundwater discharge R_g (inches)	+	Evapotranspiration ET (inches)
			CONOCOCHEAGUE CREEK				
1966	30.72	=	2.58	+	6.05	+	22.09
1967	40.68	=	3.82	+	9.96	+	26.90
1968	37.08	=	3.74	+	10.87	+	22.47
1969	32.93	=	2.08	+	6.33	+	24.52
1970	47.73	=	5.90	+	13.93	+	27.90
1971	42.42	=	5.89	+	15.58	+	20.95
1972	49.03	=	11.15	+	18.56	+	19.32
1973	53.50	=	8.31	+	19.80	+	25.39
1974	42.90	=	5.94	+	15.51	+	21.45
1975	54.00	=	8.78	+	15.01	+	30.21
1976	39.31	=	4.18	+	13.21	+	21.92
1977	40.19	=	5.86	+	11.04	+	23.29
1978	43.07	=	7.07	+	15.47	+	20.53
13-year average	42.58	=	5.79	+	13.18	+	23.61
Percent of total	100	=	14	+	31	+	55

[1] November 6 to November 5 the following year.

average quantities of water that move through each part of the system annually.

Precipitation (P)

The records of six U. S. Weather Bureau stations (U. S. Department of Commerce, Environmental Data Service, 1966-1978) and one temporary rain gage were used to calculate precipitation for the basins analyzed. Precipitation varies greatly from month to month (Figure 6), but the long-term records indicate that average monthly precipitation is distributed evenly throughout the year. The greatest precipitation occurs on South Mountain. Precipitation is slightly lower in small valley and high ridge areas to the west, and least in the central part of the main valley. Thus, the Antietam Creek basin has the highest average annual precipitation (44.1 inches) because it includes a large part of South Mountain. The Back Creek basin, located mostly in the main valley, has the lowest precipitation, averaging 41.2 inches per year (13-year average). Annual precipitation in the Conococheague basin averages 42.6 inches as it includes both the eastern and western mountainous areas.

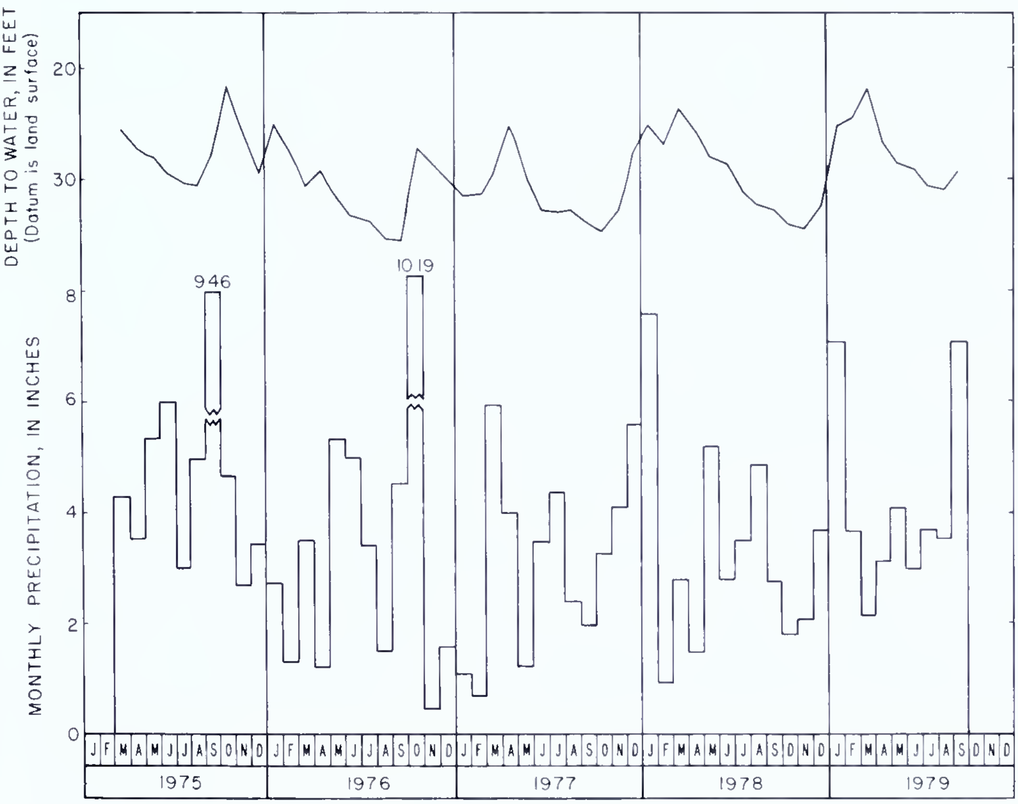

Figure 6. Precipitation at Chambersburg and fluctuations of water levels in well Fr-332 at Greencastle Reservoir.

Streamflow ($R_g + R_s$)

Streamflow was obtained from the records of the U. S. Geological Survey for gaging stations (U. S. Geological Survey, 1966-1978) on Antietam Creek, near Waynesboro, on Conococheague Creek, at Fairview, Maryland, and on Back Creek, near Turkeyfoot. Data for Back Creek span a period of 2 years and, therefore, cannot be compared with long-term records for the other stations. The groundwater and surface-flow components of streamflow were separated on the hydrographs using conventional methods.

On the average, 83 percent of the flow of Antietam Creek is derived from groundwater (base flow). During the 13-year period analyzed, the groundwater contribution ranged from 72 to 88 percent of the total flow. The groundwater contribution to flow was somewhat less for Conococheague Creek, averaging about 70 percent and ranging between 62 and 76 percent. About 63 percent of the flow of Back Creek is derived from groundwater, based on the 2 years of streamflow records.

Differences in the percentage that groundwater contributes to flow primarily reflect the effect of geology on hydrologic characteristics of the basins, although topography and land use also may be significant factors. The Back Creek basin is predominantly underlain by shale, whereas Antietam Creek flows mostly through carbonate terrain. About 35 percent of the area drained by Conococheague Creek is underlain by carbonate rocks, and the remainder is underlain by shale and some sandstone.

Evapotranspiration (ET)

Evapotranspiration is a term that describes evaporation from water bodies, wetted surfaces, and moist soil by direct evaporation and vapor that escapes from living plants by the process of transpiration. The amount of ET varies with the length of the growing season, average temperature, amount and timing of precipitation, and humidity. Therefore, consumptive losses of ET are at a minimum from early fall to late spring, and recharge to groundwater is at a maximum. The effect can be seen in the annual fluctuations in water level as shown in Figure 6 for well Fr-332. The amount of water lost to ET in the area was estimated by computing the difference between precipitation and streamflow for the long-term budget periods.

The average water lost to ET in the Conococheague Creek basin is 23.6 inches or about 55 percent of precipitation. These values agree with the 23.1 inches and 55 percent of precipitation obtained for the Conodoguinet Creek basin located just to the north (Becher and Root, 1981). The amount of ET is higher for the Antietam Creek basin, averaging about 27.1 inches or 61 percent of precipitation. Land use and topography in the Antietam Creek basin are similar to those in the Yellow Breeches Creek basin further north, but ET averages 48 percent of precipitation in the latter. Either ET is sub-

stantially greater in the heavily forested Antietam basin or from 3 to 6 inches of precipitation bypasses the stream gage as groundwater. As this water is not measured by the gage, it is placed in the residual term (ET) of the budget equation.

Groundwater Storage (ΔS)

During years of above normal precipitation there will be a net increase in the amount of groundwater stored in the subsurface, and conversely, a net decrease during years of below average precipitation. Over a long period, the net changes will balance one another. Thus, in the budget analyses in Table 2, changes in groundwater storage are considered to be zero.

Groundwater Yields by Area

Groundwater discharge per unit of land surface is a practical estimate of the limits of development for a basin or aquifer. Quantities determined from the water budget and from base-flow measurements at ungaged sites were used to calculate the groundwater yields shown in Table 3. The yield given for carbonate rock is valid for areas near South Mountain. It was calculated from data for the Antietam Creek basin and, therefore, includes storage effects from the colluvium. Carbonate rocks further west may have lower yields. Average yields for the Martinsburg shale are based on an analysis of data for the Back Creek basin.

Total use of water averages less than 4 percent, and consumptive use less than 1 percent, of average groundwater yield. Therefore, a large potential for widespread development of groundwater exists, and can be tapped before significant adverse effects on water levels and streamflow will occur. Interpretations are based on average yields of relatively large areas, and do not consider areal differences caused by variations in the hydrologic properties of the rocks and seasonal differences in yield that follow the trends of groundwater levels. Yields of wells on a formation-by-formation basis are shown in Table 1 and in the map explanation on Plate 1.

Movement of Groundwater

Recharge to the groundwater system occurs almost everywhere except where stream channels penetrate below local groundwater levels. Where this condition occurs, groundwater is discharged. In the carbonate rocks, groundwater levels are below stream channels along some reaches, especially during summer and fall, and the streams then may lose water to the groundwater system.

A water-level map can be used with geologic, chemical, and other hydrologic information to provide both qualitative and semiquantitative information about the groundwater system. Plate 1 shows the generalized water-lev-

Table 3. *Groundwater Yield Estimated from Baseflow*

Area	Yield (ft³/sec)/mi²	Yield (Mgal/d)/mi²
	AVERAGE DISCHARGE	
Antietam Creek basin[1]	1.04	0.67
Conococheague Creek basin[1]	.97	.63
Eastern carbonate rocks[1]	1.32	.85
Martinsburg Formation	.74	.48
	MAXIMUM DISCHARGE	
Antietam Creek basin[2]	1.44	.93
Conococheague Creek basin[3]	1.45	.94
	MINIMUM DISCHARGE[4]	
Antietam Creek basin	.43	.28
Conococheague Creek basin	.45	.29

[1] 13-year average (1966-78).
[2] 1972.
[3] 1973.
[4] 1966.

el configuration. Most water levels were measured during the summer and fall seasons of 1977-79. Topography was used as a guide in constructing the contour map. The contour interval is 50 feet except to the northeast, along the steep slopes of Path Valley, where data are scanty. In general, groundwater moves down gradient along flow paths perpendicular to the contour lines. Details of the groundwater system are more complex than could be contoured, and local flow may be in any direction.

The divides between major groundwater basins were defined by water-level contours, but compare well with topographic divides. Little evidence was found to indicate interbasin flow movement across these divides.

In the main carbonate valley, groundwater movement is most free parallel, and least free perpendicular, to the strike trend of bedding. This is shown by the northeast orientation of water-level contours. However, contours on the Antietam Creek basin take a crude semicircular form subparallel to the formation contact lines that define the nose of a complex north-plunging fold in the southeastern part of the main carbonate valley.

Contours on water levels in the Martinsburg Formation show little preferred orientation except on steeply dipping graywacke sandstone. Here, bedding probably enhances flow parallel to strike.

The spacing of contour lines on the groundwater surface indicates the relative ability of rocks to transmit water; wide spacing indicates a greater ability than narrow spacing. In general, the contour spacing indicates that the carbonate aquifer has a transmissivity several times that of the Martinsburg.

Springs

Springs provide considerable information about the groundwater system. In carbonate rocks, they are major points of discharge and potential sources of large supplies of water. Of the 19 springs in Table 14, seven are capable of supplying more than 1 million gallons of water per day; most are not presently being used. Table 14 includes most of the larger springs, and provides information on discharge and on-site water-quality measurements.

WATER-YIELDING PROPERTIES OF THE ROCK UNITS

Rocks that can supply usable quantities of water to wells and springs are called aquifers. Openings in unconsolidated-rock aquifers, such as the colluvium adjacent to South Mountain, occur primarily as voids between packed grains. However, most of the openings in rocks of the Cumberland Valley occur as separations along breaks in the consolidated-rock mass. A well must intercept at least one opening or water-bearing zone to obtain any water. Data on the distribution of water-bearing zones, together with statistics on other well completion characteristics, are useful in assessing the yield capability of aquifers. Table 4 summarizes information on water-bearing zones and Table 5 summarizes other well completion statistics.

Evaluation of these data is useful in making pre-drilling estimates of relative construction characteristics. For example, the difference between the median depth of wells in the Martinsburg and the carbonate-rock units indicates that adequate yields are obtained at much shallower depths and therefore at much lower cost from the Martinsburg. Similarly, a comparison of data from all Ordovician and Cambrian carbonate formations indicates that wells in the latter require much more casing, have deeper water-bearing zones, and have deeper water levels. In practical terms, wells in the Cambrian units will cost more to construct and require greater pumping lifts to obtain the same amount of water as wells in Ordovician carbonates. However, because the wells are cased deeper and the water levels and yield zones are deeper, the water is less susceptible to contamination.

Well construction data are also helpful in making decisions during the drilling of a well. For wells being drilled for high yields, the depth data on yielding zones in Table 4 are valuable both for planning optimum well depth and for making decisions during drilling on whether to deepen the well in search of additional water. For example, the depth of a well in the Rockdale Run Formation might be planned for 200 feet to take advantage of the depth of maximum development of yield zones (51-150 feet) and to penetrate more than half the zones (median 101-150 feet). If the quantities of water obtained to that depth were only marginally adequate, it might be practical to deepen the well even to as much as 400 feet, as data indicate additional zones were penetrated to this depth.

Table 4. *Distribution of Yield Zones in Wells*

Rock unit(s)	Number of wells	Total yield zones	Depth ranges of yield zones (feet) — Number of zones/zones per 100 feet of hole drilled (or footage drilled)								
			0-50	51-100	101-150	151-200	201-250	251-300	301-350	351-400	400
Martinsburg Fm.	188	365	121/1.3	182/3.0	46/1.9	13/1.6	2/0.28	1/0.48	0/(72)	0/(50)	0/(10)
Shale	167	327	108/1.3	[1]162/3.0	44/2.1	10/1.1	2/ .28	1/ .48	0/(72)	0/(50)	0/(10)
Graywacke	21	38	13/1.3	[1]20/1.3	2/ .74	3/2.5	0/(50)	-/-	-/-	-/-	-/-
Ordovician carbonate formations	170	275	37/ .44	[1]103/1.4	59/1.2	39/1.1	18/ .75	4/ .27	7/ .73	5/ 1.2	3/1.1
Chambersburg Fm.	17	25	5/ .60	7/1.1	[1]7/1.3	4/1.0	2/ .67	0/(127)	-/-	-/-	-/-
St. Paul Gp.	54	91	10/ .37	37/1.6	[1]20/1.3	7/ .63	8/1.1	0/(410)	6/2.2	2/ 2.0	1/ 0.40
Pinesburg Station Fm.	14	20	1/ .14	9/1.5	1/ .25	5/1.4	1/1.4	1/ .50	0/(172)	1/ .58	1/ .56
Rockdale Run Fm.	68	115	17/ .50	38/1.3	27/1.2	21/1.4	7/ .71	3/ .40	1/ .25	1/ .51	0/(204)
Stonehenge Fm.	15	21	3/ .41	[1]11/1.8	4/1.3	2/1.1	0/(102)	0/(96)	0/(50)	1/ .50	-/-
Stoufferstown Fm.[2]	2	3	1/1.0	1/1.0	0/(90)	0/(50)	0/(50)	0/(50)	0/(50)	0/(50)	1/ .60
Cambrian carbonate formations	113	189	18/ .46	71/1.9	46/1.8	20/1.1	17/1.3	11/1.2	2/ .36	2/ .61	2/ 1.5
Shadygrove Fm.	13	19	3/ .50	5/ .90	[1]6/1.5	1/ .33	1/ .43	2/1.3	0/(50)	0/(50)	1/ 1.2
Zullinger Fm.	32	54	3/ .20	21/1.4	[1]15/1.3	5/ .69	5/ .79	4/ .93	1/ .36	0/(167)	0/(33)
Elbrook Fm.	34	60	9/ .53	[1]31/2.1	10/1.1	5/ .78	2/ .66	1/ .40	0/(129)	1/ 1.4	1/ 1.4
Waynesboro Fm.	11	16	2/ .36	4/ .75	[1]4/1.1	4/1.6	2/ .40	-/-	-/-	-/-	-/-
Tomstown Fm.	23	40	1/ .09	10/ .90	[1]11/1.6	5/1.0	7/1.8	4/1.2	1/ .44	1/ .92	0/10

[1] Depth range in which median yield zone occurs.
[2] Insufficient data.

Table 5. *Summary of Well, Casing, and Water-Level Depths*

Rock unit	Number of wells	Well depth (feet)		Number of wells	Casing depth (feet)		Number of wells	Depth to water (feet)	
		Median	Maximum		Median	Maximum		Median	Maximum
Colluvium	7	80	260	7	80	260	7	30	70
Martinsburg Fm., shale	246	88	437	204	24	115	189	20	62
Martinsburg Fm., graywacke	35	85	250	27	23	68	29	20	70
Ordovician carbonate formations									
Chambersburg Fm.	34	160	356	24	21	62	22	26	111
St. Paul Gp.	73	130	723	62	23	240	67	30	74
Pinesburg Station Fm.	20	128	540	18	21	190	16	34	48
Rockdale Run Fm.	95	157	604	81	28	157	75	29	100
Stonehenge Fm.	20	120	370	16	31	92	19	32	91
Stoufferstown Fm.	6	145	573	2	37	39	6	16	30
Cambrian carbonate formations									
Shadygrove Fm.	16	172	485	14	50	142	12	37	70
Zullinger Fm.	49	151	433	41	20	82	44	40	100
Elbrook Fm.	49	130	470	41	40	127	45	43	109
Waynesboro Fm.	16	148	248	14	69	195	13	58	92
Tomstown Fm.	24	130	410	22	87	238	22	58	200

Data for the St. Paul Group show the deepest testing of any unit and the greatest number of deep yielding zones (Table 4). Between 251 and 300 feet, no zones are reported, but between 301 and 400 feet the number of zones per 100 feet of hole sampled is greater than in the range of maximum development. However, with the exception of one well located on a fault, none of the deep zones yield large amounts of water.

Wells intended for single-dwelling use should be drilled to about 200 feet to adequately test the site if sufficient amounts of water have not been developed at shallower depths. If some water has been obtained, deeper drilling will provide a storage reserve in the borehole, even if no additional yielding zones are penetrated. However, dry holes that penetrate only fresh rock to 200 feet are unlikely to obtain water from greater depths.

Specific Capacity

Rocks differ greatly in their ability to supply water to wells. Pumping tests of 1-hour duration performed by project personnel on 103 wells and selected test results from drillers' reports on 210 wells were used to evaluate the water-yielding capability of the various units. The results of these tests are shown in Table 13 as the specific capacity of the well. Figure 7 illustrates how a pumping test is done and how the specific capacity is calculated. Specific-capacity data are used to compare the yields of wells grouped according to rock formation as well as other criteria that are related to the yield. For example, a greater susceptibility to solution by water produces a much higher-yielding aquifer in carbonate rock than in other kinds of consolidated rock. Although the median specific capacity of 0.68 (gal/min)/ft for wells in the carbonate rocks is slightly less than the median of 0.8 (gal/min)/ft for wells in the Martinsburg Formation, about 15 percent of the wells in the carbonate rocks have specific capacities greater than the maximum of wells in the Martinsburg.

Little difference exists between the specific capacities of small supply (domestic, stock, commercial, recreation) wells and large supply (public supply, industrial, irrigation, institutional, cooling) wells in either carbonate-rock formations or the Martinsburg Formation. However, the specific capacities of large supply wells would have been greater if the wells had been pumped at the low rates of small supply wells, because drawdowns would have been less. The large supply wells have higher specific capacities because they are located almost exclusively on the best sites available. Small supply wells are almost exclusively located for economy and convenience. The analysis of specific capacities in carbonate rocks does not include the many abandoned dry holes at some locations. About 15 percent of holes drilled for small supplies are dry or nearly dry, and more than 75 percent of holes drilled for large supplies are abandoned as unsuccessful. Few wells in

A = Depth to static-water level in feet
B = Depth to pumping-water level in feet
Drawdown = B-A
C = Maximum possible drawdown
Q = Yield in gallons per minute

$$\text{Specific capacity} = \frac{\text{Yield}}{\text{Drawdown}} = \frac{Q}{B\text{-}A}$$

For example: water stands 62 feet below the surface before a well is pumped (A = 62 feet). The pump is run for an hour and is measured by filling a 55-gallon drum in 10 minutes ($Q = \frac{55}{10} = 5.5$ gallons per minute). The water level is then found to be 73 feet below the surface of the ground (B = 73 feet). The drawdown is then 73 − 62 = 11 feet and the specific capacity is $\frac{5.5}{11} = 0.5$ gallon per minute per foot of drawdown. If the well is 100 feet deep, the maximum possible drawdown (C) is 100 − 62 = 38 feet. Therefore, the maximum rate at which the well could ever be pumped is $0.5\ \frac{\text{gpm}}{\text{feet}} \times 38$ feet = 19 gallons per minute.

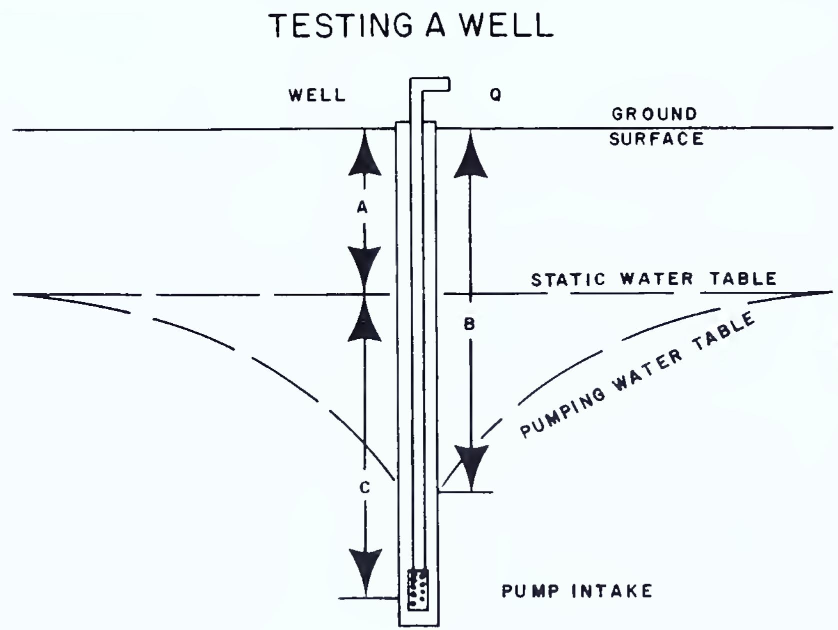

Figure 7. How specific capacity is determined from a pumping test (from Landers, 1976, p. 37).

the Martinsburg are abandoned as dry holes and less than 30 percent drilled for large supplies are abandoned as unsuccessful.

Sustained Yield

Specific-capacity data also can be used to estimate a sustained yield—a quantity more directly useful in selecting areas for development of high-production wells. The sustained yield is defined as the amount of water, in gallons per minute, that can be obtained continuously from a well for 24 hours. It was calculated by multiplying the median specific capacity after 24 hours of pumping by the available drawdown. The specific capacity for 24 hours was calculated by reducing the median specific capacity obtained for each formation after 1 hour of pumping by the average decline observed in wells pumped for 24 hours. Average declines of 30 percent and 35 percent were observed in the field for wells in carbonate and shale, respectively. The available drawdown is the difference between the median depth to water under nonpumping conditions and the midpoint of the depth range of the median-yield zone. Table 6 summarizes the water-yielding capabilities of the rocks. Although the median specific capacities of the Stonehenge and Elbrook Formations are noticeably higher than those of other formations, the calculated sustained yield is less than might be expected because the shallowness of the yield zones reduces the available drawdown.

Although data are inadequate to calculate a sustained yield, the specific capacities of 0.14 and 150 (gal/min)/ft for the two wells (Fr-336 and -338) in the Stoufferstown Formation might imply a high-yield formation. The Stoufferstown is a very thin formation that occurs stratigraphically between the high-yielding Shadygrove and Stonehenge Formations. Characteristics that make the latter two high yielding also can enhance yields near the contacts with other formations (Meisler, 1963, p. 22). However, both wells are at the same location—a discharge area with several springs—and may not be indicative of the overall yield capability of the Stoufferstown.

The right-hand column of Table 6 shows the median yields determined from well data reported by drillers. The majority of these wells were never tested for high yields because they were drilled for domestic and other uses that do not require large supplies of water. Hence, wells reported to yield 20 or 30 gal/min may be capable of much larger yields.

A comprehensive evaluation of the water-bearing characteristics of each rock unit is given in Table 1 and is based on the sustained-yield calculations, specific-capacity data, maximum reported yields of operational wells, and the percentage of wells that cannot supply minimum domestic needs without standby storage during periods of peak demand. Wells that have a reported yield less than 5 gal/min or a specific capacity less than 0.08 (gal/min)/ft are defined as inadequate to meet minimum domestic needs.

Table 6. *Summary of Water-Yielding Capability of Rocks*

Rock unit(s)	Number of wells	Specific capacity ([gal/min]/ft)[1] 25 Percent	Specific capacity ([gal/min]/ft)[1] Median	Specific capacity ([gal/min]/ft)[1] 75 Percent	24-Hour median specific capacity[2] ([gal/min]/ft)	Available[3] drawdown (feet)	Calculated median sustained yield (gal/min)	Number of wells	Median reported yield[4] (gal/min)
Colluvium	5	5.4	0.5	0.14	0.35	50	18	7	20
Martinsburg Formation, shale	91	2.7	.80	.31	.52	55	29	210	20
Martinsburg Formation, graywacke	13	2.9	1.4	.7	.91	55	50	28	20
Chambersburg Formation	11	.7	.22	.05	.15	75	11	26	7
St. Paul Group	31	3.0	.28	.03	.20	75	15	62	15
Pinesburg Station Formation	5	2.8	.88	.08	.62	75	46	13	10
Rockdale Run Formation	41	4.2	.60	.07	.42	75	32	82	13
Stonehenge Formation	8	17	4.5	.04	3.2	43	138	17	20
Stoufferstown Formation	2	[5]	[5]	[5]	[5]	59	[5]	3	15
Shadygrove Formation	9	4.6	1.3	.04	.91	75	68	15	20
Zullinger Formation	31	7.5	.76	.13	.53	75	40	43	14
Elbrook Formation	29	11	2.0	.16	1.4	32	45	40	15
Waynesboro Formation	12	5.7	.9	.31	.63	67	42	13	12
Tomstown Formation	18	2.3	.71	.31	.50	67	34	24	15

[1] Based on frequency distributions of 1-hour pumping tests. Values shown are exceeded by the indicated percentage of wells.
[2] Based on field data showing average decline of specific capacity.
[3] Based on midpoint of depth range of median yield zone from Table 4 and median depth to water from Table 5. Median casing depth instead of yield zone data used for colluvium. Maximum drawdown allowed is 75 feet.
[4] From well-completion reports filed by drillers.
[5] Insufficient data.

Some details about the water-bearing characteristics of the Tomstown and Waynesboro Formations and the overlying colluvium are not given in Table 1. Unconsolidated material along the flanks of South Mountain, on the east, and Cove Mountain, on the west, consists of poorly sorted deposits, mostly residuum from rock weathering, talus, and other deposits of mass wasting. These are collectively called colluvium. In general, the colluvium is thickest on the mountain slope above the contact between quartzitic rocks rimming South Mountain and the Tomstown Formation, but the thickness varies greatly over short distances. The material thins in the downslope direction and grades into the normal regolith of the valley. In Franklin County, the colluvium attains a maximum reported thickness of 260 feet, but to the north, in Cumberland County, the material is generally thicker and attains a maximum known thickness of 450 feet (Becher and Root, 1981). Wells are cased to the yielding zone, which is sometimes in a sand or gravel lense, but more commonly in the zone just above bedrock. Water enters the well only through the open end of the casing; therefore, the yield potential determined from pumping-test data is probably less than the true potential. A few wells (Fr-103, -107, -135) yield from sand and gravel deposited by Conococheague Creek several miles east of the colluvium on South Mountain. These deposits are better sorted and therefore have greater yielding ability than most colluvial deposits. Little effort is made to develop wells in the colluvium.

The Tomstown Formation and, to a lesser degree, the Waynesboro Formation are deeply weathered and covered by colluvium. This unconsolidated material stores additional water that recharges the underlying bedrock and is itself recharged by runoff from South Mountain.

Data on depths of water-bearing zones (Table 4) in the Tomstown and Waynesboro are deceptive because they include the overlying colluvium. The median thickness of bedrock penetrated by wells is 55 feet in the Tomstown and 72 feet in the Waynesboro. Of 36 wells in both formations, only 11 penetrate more than 100 feet of bedrock, and, of these, only 4 penetrate more than 200 feet of bedrock. Three of the four reached water-bearing zones near the maximum depth of the well and are among the highest yielding wells in these formations. The number of water-bearing zones changes little with increased depth in the first 200 feet of bedrock, when weighted to eliminate differences in the amount of hole drilled. Therefore, wells should be drilled at least 200 feet into bedrock, beneath the colluvium, to adequately test these formations. Wells in the Tomstown and Waynesboro require considerably more casing than wells in other formations (Table 5) because of the thick colluvium. Boulders and residual blocks of carbonate rock may cause difficult drilling, crooked boreholes, or loss of the hole during drilling through the colluvium. Large, open or clay-filled cavities that contain rounded quartzite boulders or loose bedrock projections in the borehole also create problems in drilling and well development.

Factors that Influence the Yields of Wells

Wells obtain water from zones created by many processes, from those active in the earliest formative period of the rocks' history to those now active. In the Cumberland Valley, these zones may be openings along bedding surfaces or separations on fault, joint, and cleavage surfaces produced by physical stress during movements of the earth's crust. Any type of opening may be enlarged by natural chemical action. Figure 8 shows examples of openings in rocks as they appear near the land surface.

Figure 8. View, facing west, of vertical joints in gently dipping, thin-bedded limestone of the St. Paul Group. The large vertical solution opening is developed along a joint perpendicular to the regional strike.

The size, spacing, distribution, orientation, and extent of interconnection of openings determine the ability of the aquifer to store and transmit water and, therefore, the ability of wells to yield water. At a site, any, all, or none of the types of openings may be present in the subsurface.

The selection of drill sites having the greatest yield potential, or, conversely, the avoidance of sites that have little or no yield potential requires interpretation of surface and subsurface information that reflects geologic conditions favorable or unfavorable for the occurrence of openings.

Differences in Openings Formed by Cleavage, Bedding, Joints, and Solution in Different Rock Types

The kind of rock is more important than any other geologic factor in determining the character of openings. In shale of the Martinsburg, a network of intersecting openings is formed by minute cleavage partings, spaced about 1/4 inch apart; joints, spaced an inch to a foot apart; and bedding, spaced one to several feet apart (Figure 9). An opening rarely exceeds a few tenths of an inch in width. As a result, the distribution of many small openings is fairly homogeneous and the specific capacities of 99 percent of the wells range over only one order of magnitude, from 0.1 to 8.0 (gal/min)/ft.

In the limestone formations, joints up to 1/2 inch in width and spaced 3 to 5 feet apart, and bedding separations spaced 1/2 inch to 6 feet apart are

Figure 9. Steeply dipping cleavage in a small fold in shale of the Martinsburg Formation. The hammer is on a joint face perpendicular to cleavage and the axis of the fold.

Figure 10. View, facing west, of solution openings developed along vertical fractures perpendicular to vertical beds in limestone of the St. Paul Group.

the primary openings. Weak acids in rain and soil water slowly enlarge these primary openings, especially at intersections, creating cavities that generally range from a few inches to a foot in diameter (Figure 10) and, rarely, caverns that may be tens of feet in width and hundreds of feet in length. As a result, openings vary greatly in size and distribution and the specific capacities of wells range over nearly five orders of magnitude, from 0.01 to 950 (gal/min)/ft.

In dolomite of sufficient thickness, such as in the Pinesburg Station Formation, and in graywacke sandstone of the Martinsburg, bedding and joints form the water-bearing zones. The openings are generally smaller than in limestone. Enlargement of openings by solution occurs in the dolomite, but the process is slower and less effective at creating large openings than in

limestone. Specific capacities range over two orders of magnitude for both rock types, from 0.08 to 6.6 (gal/min)/ft.

Orientation of Bedding, Joints, and Solution Openings

The orientation of openings is important in the evaluation of well sites. Bedding, joints, and solution openings impose characteristics on rocks that may be identifiable in land-surface features.

Bedding strikes dominantly northeast, parallel to the valley, but varies as shown by the lines of formational contacts in Figure 3. The beds generally dip from 25 degrees to vertical, but gentler dips are common. Joints occur principally in two sets. The strike of the dominant set is within 10 degrees of perpendicular to the strike of bedding and is nearly vertical. The other set is subparallel to the strike of bedding and is moderately to steeply inclined. More detailed information on joint orientation is given in reports about the geology such as Root (1971) and Clark (1970).

Information on the orientation of solution features has been compiled from cavern exploration trips and published by the National Speleological Society (Smeltzer, 1964). The data have been generalized for each cave and plotted on Plate 1. Of 34 caves for which there are adequate data, solution passages have developed only along joints in 11 caves, only along bedding in 7 caves, and along both bedding and joints in 11 caves, and are unrelated to known structure in 5 caves. Solution passages have developed most commonly in vertical or steeply dipping beds or joints. Where solution passages developed along joints, those parallel to the strike of bedding form the sole or dominant passage direction in 10 of 11 caves. Solution passages along joints perpendicular to strike in all but 2 of 14 caves are subordinate to passages in other directions. Passages along bedding are the dominant or only solution-enlarged openings in 13 caves. In summary, solution development is greatest along vertical or steeply inclined beds or joints subparallel to the strike of bedding. Data from pumping tests support this observation.

Wells in both limestone and shale that are located along strike from a pumping center commonly show a greater drawdown response than do wells across strike. This effect was observed during pumping tests on Fr-336 and its well field, in limestone east of Greencastle near the Greencastle Reservoir, and on Fr-496 and its well field in shale at the Paul Bert farm, several miles northeast of the Letterkenny Army Depot. The orientation of bedding and joints parallel to bedding controls the anisotropic pumping effects in limestone. In shale, however, either vertical cleavage, joints, or bedding may be the controlling factor.

Faults

Faults may create openings that will yield substantial amounts of water. Examples of wells that probably intercept fault-related openings are Fr-328

and -529 in carbonate rocks and Fr-501 in the Martinsburg Formation. However, faults are commonly filled with clay, calcite, or quartz and may yield little or no water, especially faults in carbonate rocks. The distribution and orientation of known faults are shown on Plate 1. Detailed discussions of faults can be found in geologic reports about the area (Root, 1968; Clark, 1970).

Relationship between Topography and Yielding Capability

Many studies (Meisler and Becher, 1971; Wood and others, 1972; Nutter, 1973) have evaluated the relationship of topography and well yield using specific-capacity data. In general, wells in higher topographic positions have smaller yields than wells in lower positions. Valleys and draws form where the rocks are most susceptible to physical or chemical weathering, and hills form on the more resistant rocks. Openings such as bedding, joints, cleavage, faults, and solution features promote rapid weathering and can produce low areas in the topography. Lower topographic positions are the collecting areas through which all upslope water eventually must drain, and, therefore, these lower areas must have a capability for handling greater amounts of water for each unit volume of rock than topographically higher positions.

An analysis of the relationship between topography and the specific capacities of wells gave results similar to earlier studies and are shown below. Topography has a much greater effect on yield in carbonate rocks than in shale and graywacke sandstone.

Median Specific Capacity, in (gal/min)/ft, for the Given Topographic Position

	Hilltop	Hillside	Gully or draw	Flat	Valley
Carbonate rocks	0.25	0.5	0.9	3.1	5.5
Shale and graywacke	.67	.9	.62	1.7	1.9

Fracture Traces

Fracture traces are tonal, vegetal, or topographical lineations observed on aerial photographs that are attributed to vertical or near vertical fractures or zones of fracture concentration in the subsurface rock (Lattman, 1958, p. 569). In areas where most of the groundwater occurs in fractures, wells drilled on fracture traces should be more productive than those located either randomly or by use of other geologic and hydrologic criteria. Results of the application of the fracture trace method are presented in

many published reports (Meisler, 1963, p. 33; Lattman and Parizek, 1964; Hollowell and Koester, 1975, p. 29; and Becher and Root, 1981, p. 35-37). Most reports indicate at least a partially successful use of the procedure, although a few have disclosed negative or inconclusive results.

The fracture trace method is a variation or extension of the topographic method of well location. Fracture traces in terrane underlain by shale of the Martinsburg are largely associated with alignments of topographic features such as linear segments of valleys. The same is true of carbonate terrane, although tonal alignments are more abundant. The relationship between tonal alignments observed on aerial photographs and well yields has not been thoroughly evaluated. Nutter (1973, p. 26) stated in reference to topographic lineations that "some subtle topographic features may be more easily observed in the field than on aerial photographs."

Data for 20 wells in carbonate rock that are known to be intentionally positioned on fracture traces are given in Table 7. Half have specific capacities or yields greater than the median value of wells in carbonate rock. Exceptionally high production yields are obtained from five of the wells—among the highest yields in the study area. However, five of the wells do not produce enough water for a domestic supply, either because the observed linear feature was not a surface expression of subsurface fracturing or because the site was inaccurately located in the field.

Fracture traces identified on 1:20,000 scale aerial photographs are plotted on Plate 1 to show their approximate locations, general orientation, and distribution. The traces have not been field checked. Selection of actual drilling sites must be made in the field using aerial photographs. Geologic knowledge and skill in interpreting aerial photographs are needed to apply this method of selecting well sites.

Specific Yield of the Martinsburg Formation

Specific yield is an estimate of the volume of water that can be obtained from a unit volume of aquifer by gravity drainage. As a unit measure of aquifer storage, it may be used to calculate the effects of groundwater development on water levels. An average specific yield of 0.005 (0.5 percent) was calculated for the zone of water-level fluctuation in the Martinsburg Formation for nine periods ranging from 3 to 17 days' duration. Values of single periods ranged from 0.0005 in early fall to 0.0087 in early spring. All periods began 3 days after rain had ceased, when no snow was on the ground. The average value for six periods during fall is 0.002 and for three periods during spring is 0.006. Fall values are affected by evapotranspiration to a greater extent than spring values.

Trainer and Watkins (1975, p. 41) calculated similar storage values for "fractured rocks having thin regolith" in the Potomac River basin. Pumping tests during this study on two small well fields in the Martinsburg gave storage values between 0.002 and 0.006.

Table 7. *Characteristics of Wells Located on Fracture Traces*

Well number	Geologic unit	Specific capacity (gal/min)/ft	Reported yield (gal/min)	Well depth (feet)
Knouse Foods	Tomstown Fm.	—	100	412
447	do.	24	—	325
291	Elbrook Fm.	5.4	80	396
Corning Glass Works	Rockdale Run Fm.	.35	5	367
Do.	do.	—	5	334
Do.	do.	—	5	369
351	do.	.04	—	460
493	do.	.04	1	341
495	do.	.06	—	231
385	do.	2.3	—	113
405	do.	150	—	280
407	do.	300	—	295
333	do.	—	1	403
334	do.	.03	3	341
340	do.	1.2	—	111
511	do.	.5	—	105
505	Stonehenge Fm.	35	30	100
336	Stoufferstown Fm.	154	—	145
338	do.	.14	—	248
384	Pinesburg Station Fm.	.88	30	418
	Median (fracture trace)	1.0	5	295
	(all limestone wells)	0.68	14	130

Hydraulic Characteristics and Well Interference

Competition for the same water occurs when wells are too closely spaced. Interference is the result of overlap in drawdown and reduces the yield of any well within the area influenced by pumping from another well. In general, well interference increases as the space between the wells decreases. Drawdowns in the area influenced by a pumping well are determined by the transmissivities and storage coefficients of the aquifers. Table 8 summarizes the most representative transmissivities determined from pumping tests or derived from specific-capacity data, and gives theoretical drawdowns, based on the work of Theis (1963, p. 10-15), for the various aquifers. The storage coefficient for the Martinsburg is equal to the specific yields determined previously. The storage coefficient for the carbonate aquifer is based on studies in the northern part of the Cumberland Valley (Becher and Root, 1981).

Drawdown in real interference problems will differ from theoretical drawdowns because of the heterogeneous nature of these aquifers and re-

Table 8. *Summary of Hydraulic Properties and Theoretical Drawdowns Typical of the Aquifers*

Aquifer	Transmissivity (ft^2/day)	Storage coefficient	Discharge (gal/min)	Days pumped	Drawdown, in feet — Distance from pumped well: 100 ft	500 ft	1,000 ft
Martinsburg Formation	[1]150	0.005	30	30	16	6.2	2.7
				180	22	12	7.8
	[2]800	[2].002	100	30	18	11	7.8
				180	22	15	12
Stonehenge Formation	[1]600	.04	200	30	20	6.8	2
				180	29	16	8.4
	[2]4,000	[2].07	400	30	6.5	3.0	1.6
				180	8.9	4.9	3.3
All carbonates except Stonehenge Formation	[3]120	.04	50	30	18	4.4	0
				180	29	9.9	3.0
	[4]300	.04	100	30	18	4.4	.4
				180	28	12	6.1
	[2]1,000	.04	200	30	15	5.9	2.3
				180	21	11	7.0
	[2]2,000	.04	300	30	13	5.8	3.0
				180	17	10	6.8

[1] Based on specific-capacity data.
[2] Based on pumping test in a well field.
[3] Based on specific-capacity data for the Pinesburg Station, Shadygrove, Zullinger, Waynesboro, and Tomstown Formations.
[4] Based on specific-capacity data for the Elbrook Formation.

charge from precipitation. In fractured-rock aquifers, interference will be greatest along some preferred direction, generally parallel to bedding, cleavage, joints, or solution features, whichever is the dominant direction of interconnection.

The table can be used to obtain a general idea of the spacing necessary to minimize interference between wells. Drawdowns for any discharge rate can be calculated from the table because drawdown is directly proportional to discharge. Reducing the discharge by half will also reduce the drawdown by half.

QUALITY OF GROUNDWATER

Groundwater in the report area is of good quality for most uses. Routine field determinations of specific conductance, hardness, and pH of water are listed in the record of wells (Table 13) and the record of springs (Table 14). Water temperatures range from 10 to 14.5° Celsius and vary little annually. The temperature and its small variability make groundwater an excellent cooling and air-conditioning agent as well as a good source of geothermal heat.

A direct relationship exists between specific conductance (an electrical measure of the mineral content in solution) and both dissolved solids and hardness due to calcium and magnesium ions (Hem, 1970, p. 96-101). Therefore, to calculate the approximate value of these constituents of groundwater in this area, even though a laboratory chemical analysis is not available, the specific conductance can be multiplied by 0.60 to obtain the dissolved solids in milligrams per liter and by 0.48 to obtain the hardness in milligrams per liter as $CaCO_3$.

Values of pH range from 5.8 to 8.2, although about 90 percent are only slightly above or below the neutral value of 7.0. A summary of the specific-conductance and hardness values of well water is given by geologic unit in Table 9.

The median values of hardness and specific conductance increase progressively upward through the stratigraphic sequence from the Tomstown Formation (oldest) through the Zullinger Formation (youngest). In general, specific conductance increases as the length of the water's flow path increases. Longer flow paths bring the water in contact with more rock material and provide more time for solution to occur than shorter flow paths. Water from the Tomstown and parts of the Waynesboro and Elbrook Formations is of low specific conductance because the dilute water received from South Mountain has had little contact with carbonate rock. Higher in the carbonate sequence, values of specific conductance and hardness fluctuate without any apparent trend as the water is approaching chemical equilibrium with calcite and dolomite, the dominant minerals. In contrast,

Table 9. *Summary of Field Determinations of Specific Conductance and Hardness by Geologic Unit*

Geologic unit	Number of wells	Specific conductance[1] (micromhos at 25° C) 10 percent	50 percent	90 percent	Number of wells	Total hardness[1] (mg/L) 10 percent	50 percent	90 percent
Martinsburg Formation, shale	107	550	310	180	118	255	120	70
Martinsburg Formation, graywacke	14	535	225	105	14	300	120	50
Chambersburg Formation	12	840	610	385	16	390	300	180
St. Paul Group	39	800	620	360	44	360	255	180
Pinesburg Station Formation	14	1300	670	245	14	375	290	145
Rockdale Run Formation	37	1090	620	325	34	375	275	137
Stonehenge Formation	10	850	605	460	11	310	255	180
Stoufferstown Formation	3		625		3		290	
Shadygrove Formation	7		595		7		275	
Zullinger Formation	24	965	625	450	24	390	275	230
Elbrook Formation	26	935	565	340	31	390	240	120
Waynesboro Formation	12	730	320	175	12	340	135	80
Tomstown Formation	10	670	330	70	10	280	155	75

[1] Value shown is exceeded by the percent of wells indicated.

much of the water from the St. Paul Group has moved across most of the width of the carbonate valley and has a high specific conductance. Areas of excessively high specific conductance indicate a dissolved-solids content above natural levels, and where greater than 833 micromhos, higher than secondary standards set by the U. S. Environmental Protection Agency (1977).

Water from wells in the Martinsburg Formation has a lower specific conductance and hardness than water from wells in the carbonate rocks because of lithologic differences—mostly the relative abundance of calcium and magnesium minerals. No areal trends exist in the specific conductance of water from Martinsburg rocks because most of the water is discharged locally to nearby streams.

The carbonate rocks commonly yield very hard water (Hem, 1970, p. 225), except the Tomstown and Waynesboro Formations, which yield moderately hard water. Water from all Martinsburg rocks is commonly hard, although wells located near and on the slopes of Blue Mountain yield softer water. Similarly, wells in the colluvium on the north flank of South Mountain yield soft to moderately hard water.

Chemical Analyses

Thirty-nine laboratory analyses of the major chemical constituents in water from 34 wells and 4 springs are reported in Table 10. Thirty-one of the analyses are of water from the carbonate rocks. Laboratory values of nitrate alone were determined for samples from 17 wells, 12 of which are in carbonate rock; these values are not reported but are included in the evaluation of nitrate. Results of the analyses are summarized in Table 11, using the median values of the chemical constituents in water from each geologic unit that has at least six analyses.

Maximum allowable concentrations in water from public supply wells, as defined in the National Interim Primary Drinking Water Standards of the U. S. Environmental Protection Agency (1975), are exceeded for one or more constituents in 9 of 39 samples shown in Table 10. Iron concentrations exceeded the EPA limit of 0.3 mg/L in 4 of 5 samples from the noncarbonate rocks and in 2 of 27 samples from the carbonate rocks. Maximum recommended manganese concentrations of 0.05 mg/L were exceeded in all of 5 samples from the noncarbonate rocks, but in none of the 23 samples from the carbonate rocks. Iron, manganese, and hydrogen sulfide are common problems in all of the Martinsburg rocks. The origin and distribution of the hydrogen sulfide are discussed by Poth (1972, p. 24). These constituents impart unpleasant tastes and odors to the water and must bc removed for many uses.

Concentrations of nitrate in water from the carbonate rocks are well above desirable levels and are increasing. Six of the 43 samples of water

Table 10. *Chemical Analyses of Well and Spring Water*

Well or spring number	Geologic unit[1]	Date of sample	Temperature (°C)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (µg/L as Fe)	Manganese, dissolved (µg/L as Mn)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Bicarbonate (mg/L as HCO_3)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Nitrogen, nitrate, dissolved (mg/L as N)	Phosphorus, ortho-, dissolved (mg/L as P)	Solids, residue at 180°C, dissolved (mg/L)	Hardness (mg/L as $CaCO_3$)	Hardness noncarbonate (mg/L as $CaCO_3$)	Specific conductance (micromhos)	pH (units)
Fr-297	Om	6-16-69	—	19	—	—	38	12	8.3	1.4	168	21	4.1	0.1	.09	—	—	140	6	—	—
310	Om	6-18-69	—	17	—	—	38	11	8.9	2.0	158	30	1.5	.1	.20	—	—	140	11	—	—
370	Om	10-3-78	13.0	22	770	330	82	15	9.8	1.1	230	90	8.0	.2	.01	.00	349	270	79	550	7.1
378	Om	10-16-78	12.5	28	20	780	50	26	13	2.1	200	52	23	.2	.28	.00	319	230	68	500	7.0
499	Om	10-16-78	13.0	22	19000	1600	160	35	13	1.1	160	420	13	.2	.91	.00	789	540	410	1010	6.7
781	Om	8-7-79	13.0	22	500	230	62	14	15	1.7	220	26	9.7	.2	.10	.00	267	210	32	480	—
804	Om	8-7-79	11.5	29	2200	320	22	6.7	5.6	.8	69	20	6.7	.1	.09	.06	138	83	26	225	—
364	Om	5-2-79	12.0	—	—	—	—	—	—	—	99	48	59	.2	.04	.03	264	—	—	520	—
307	Oc	6-17-69	—	4.7	—	—	44	14	25	5.5	165	44	28	.1	2.7	—	—	170	29	—	—
Sp-22	Ops	8-8-79	12.0	7.2	0	5	95	27	3.9	1.7	310	15	11	.1	8.1	.00	401	350	94	695	6.8
767	Ops	8-7-79	14.0	7.9	0	3	73	37	1.0	.7	340	9.3	4.2	.1	4.0	.00	339	330	56	645	7.5
552	Ops	9-19-78	12.4	7.8	0	0	85	36	3.5	1.4	340	88	8.4	1.6	1.1	.00	467	410	130	—	7.0
684	Ops	6-4-79	12.0	7.3	50	10	50	28	1.3	.6	260	21	2.7	.0	2.6	.00	246	240	27	455	—
223	Orr	9-24-57	13.3	10	40	0	94	8.1	—	—	295	26	4.4	.1	4.5	—	325	270	26	547	7.7
334	Orr	3-31-75	—	—	260	0	95	23	—	—	258	44	14	—	2.1	—	297	330	120	—	7.5
342	Orr	3-26-75	—	—	180	0	89	28	—	—	272	17	7.1	0	2.0	—	405	336	110	—	7.4
351	Orr	6-2-75	—	—	110	20	76	41	—	—	315	7.2	4.9	.2	.95	—	410	360	100	—	7.2
405	Orr	5-20-71	—	—	100	0	—	—	—	—	205	14	10	.1	7.0	—	324	214	46	—	7.5
407	Orr	5-20-71	—	—	200	0	—	—	—	—	213	9.0	11	.1	8.0	—	330	222	47	—	7.2
511	Orr	3-3-71	—	—	100	<50	—	—	—	—	98	—	16	.6	.70	—	482	349	270	—	7.3
639	Orr	9-19-78	11.5	8.5	20	0	110	8.9	3.7	1.4	310	29	14	.1	8.7	.00	367	310	57	—	6.6
Sp-1	Orr	11-10-71	11.5	—	—	—	95	9.4	32	—	291	39	29	—	6.8	.01	—	280	37	647	7.8
505	Osh	9-19-78	12.1	11	500	0	150	7.9	5.7	1.5	340	31	21	.1	17	.00	519	410	130	—	6.4
525	Osh	9-20-78	12.0	8.6	5300	20	120	9.1	5.3	2.9	300	36	16	.2	7.1	.00	367	340	92	—	6.6
388	Ce	11-24-75	—	—	19	—	99	51	65	8.0	567	83	51	—	40	—	589	456	460	—	7.0
389	Ce	7-24-73	—	—	150	—	72	30	50	23	154	22	178	—	13	—	486	336	210	—	7.5

445	Ce	9-26-66	—	12	300	—	89	26	—	—	378	42	20	—	1.6	—	442	330	20	—	7.2
457	Ce	9-20-78	13.6	8.4	10	0	64	31	1.7	1.1	260	34	5.5	.5	7.9	.00	306	290	74	—	6.8
459	Ce	11-23-77	—	—	60	<50	71	24	—	—	236	33	26	.3	2.6	—	395	277	83	—	7.3
Sp-2	Ce	10-30-25	9.0	13	120	—	61	18	3.5	—	244	15	4.5	—	1.5	—	—	230	26	—	—
Sp-2	Ce	11-10-71	11.0	—	—	—	68	19	16	—	275	21	7.5	—	6.8	.00	—	250	22	527	7.8
Sp-3	Ce	11-10-71	11.0	—	—	—	51	22	14	—	240	21	8.0	—	5.0	.03	—	220	21	477	7.9
477	Csg	9-19-78	13.0	9.5	90	0	110	16	2.8	2.1	320	32	15	.2	8.8	.00	373	340	79	—	6.7
753	Csg	8-8-79	12.0	9.5	10	6	110	9.8	3.1	1.7	270	15	12	.2	9.2	.00	373	320	94	650	6.4
421	Czl	7-3-78	—	10	50	10	110	10	3.5	2.1	280	59	12	.1	2.0	.00	398	320	87	—	—
471	Czl	9-20-78	11.6	11	50	0	100	18	3.5	2.0	320	25	20	.2	11	.00	382	320	62	—	6.6
408	Ct	4-21-78	12.0	6.6	0	10	34	19	1.8	.9	180	8.3	1.8	.0	1.0	.00	160	160	16	295	7.6
447	Ct	11-15-74	—	—	20	10	—	—	—	—	111	12	4.5	.1	3.4	.09	186	114	23	—	7.4
441	Cwb	9-20-78	12.7	9.9	70	10	110	36	7.3	13	350	58	31	.3	11	.00	483	420	140	—	6.9

[1] Om, Martinsburg Formation; Oc, Chambersburg Formation; Ops, Pinesburg Station Formation; Orr, Rockdale Run Formation; Osh, Stonehenge Formation; Ce, Elbrook Formation; Csg, Shadygrove Formation; Czl, Zullinger Formation; Ct, Tomstown Formation; Cwb, Waynesboro Formation.

Table 11. *Median Values of Major Chemical Constituent Concentrations and Properties in Water from Selected Geologic Units*

Constituent or property	Median value/Range of values (milligrams per liter) Elbrook Formation	Rockdale Run Formation	Martinsburg Formation
Silica (SiO_2)	12 /8.4-13	9.3 /8.5-10	22 /17-28
Iron (Fe)	.09/.01-.3	.105/.02-.26	.77/.02-19
Manganese (Mn)	0 /0	0 /0-.02	.33/.23-1.6
Calcium (Ca)	70 /51-99	95 /76-110	50 /22-160
Magnesium (Mg)	25 /18-51	16 /8.1-41	14 /6.7-35
Sodium (Na)	15 /1.7-65	28 /3.7-32	9.8 /5.6-15
Potassium (K)	8 /1.1-23	1.4 /—	1.4/.8-21
Bicarbonate (HCO_3)	252 /154-567	260 /98-315	164 /69-230
Sulfate (SO_4)	28 /15-83	22 /7.2-39	41 /20-420
Chloride (Cl)	14 /4.5-178	11 /4.4-29	8.8 /1.5-59
Fluoride (F)	.4 /.3-.5	.1 /0-.6	.2 /.1-.2
Nitrate (NO_3 as N)	5.9 /1.5-40	6.4 /.7-46	.2 /.01-.91
Phosphate (PO_4 as P)	.02/0-.03	0 /0-.01	0 /0-.06
Dissolved solids (residue at 180°C)	442 /306-589	330 /297-482	293 /138-789
Calcium, magnesium hardness as $CaCO_3$	284 /220-456	295 /214-360	230 /83-540
Noncarbonate hardness as $CaCO_3$	50 /20-460	52 /26-270	32 /6-410
Number of analyses[1]	2-8	1-14	5-13

[1] Number of analyses varies because all constituents listed were not analyzed in each sample.

from carbonate rock, including 5 of the 27 taken since 1970, exceed the EPA recommended limit of 10 mg/L of nitrate (as N). The median concentrations of nitrate are 2.9 mg/L for samples before 1970 and 6.8 mg/L for samples after 1970. These amounts are not natural, but are caused by man's activities in the area. Crop fertilizers, cattle feedlots, barnyard wastes, and onlot sewage disposal systems can contribute nitrates to the groundwater. Increased activity involving these sources will increase the nitrate load, as well as other undesirable constituents, unless protective measures are instituted.

A dissolved-solids concentration of 500 mg/L (maximum recommended by EPA) is exceeded by 1 of 6 samples from noncarbonate rocks and by only 2 of the 26 samples from carbonate rocks. The existing levels indicate that man's activities are adversely affecting the quality of the groundwater.

Analyses of trace elements were made on 15 water samples from both carbonate and noncarbonate rocks, and the results are given in Table 12. Two samples slightly exceed the maximum allowable concentrations set by the EPA for the trace elements listed. The limit of lead is 50 μg/L, and the concentration in water from well Fr-525 is 52 μg/L. The limit of mercury is 2 μg/L, and the concentration in well Fr-457 is 2.4 μg/L. No natural or man-made sources could be identified for these occurrences.

PROBLEMS

Local Availability

Water problems are related to both water quality and local availability. The selection of a well site is critical in developing adequate quantities of water from wells in the carbonate rock. Many examples of drilling two or more dry or low-yield wells for domestic, farm, industrial, or public supply use in the carbonate rocks were documented during this study. Skill and care in selecting drill sites using the geologic and hydrologic information contained in this report can reduce costs and help to avoid failures in developing needed groundwater supplies. Conversely, well locations selected solely for convenience can result in greater costs and higher rates of failure to produce desired quantities of water.

Contamination of Water Quality

Water in the carbonate rocks is susceptible to contamination from land-surface activities as much water entering the aquifer receives little natural filtration in the soil horizon. Levels of nitrate in samples and many scattered reports of bacterial contamination of well and spring water indicate the magnitude of the problem. Shallow wells, wells with little casing, and some wells with ungrouted casings, sited near intensive cattle-farming activities (barnyards, feedlots, etc.) or down-gradient from septic systems, are

Table 12. *Analyses of Trace Elements in Well Water*

Geologic formation	Well number	Date of sample	Strontium, dissolved (μg/L as Sr)	Barium, dissolved (μg/L as Ba)	Lithium, dissolved (μg/L as Li)	Aluminum, dissolved (μg/L as Al)	Zinc, dissolved (μg/L as Zn)	Nickel, dissolved (μg/L as Ni)	Boron, dissolved (μg/L as B)	Bromide, dissolved (μg/L as Br)	Arsenic, dissolved (μg/L as As)	Cadmium, dissolved (μg/L as Cd)	Chromium, dissolved (μg/L as Cr)	Cobalt, dissolved (μg/L as Co)	Copper, dissolved (μg/L as Cu)	Lead, dissolved (μg/L as Pb)	Silver, dissolved (μg/L as Ag)	Selenium, dissolved (μg/L as Se)	Mercury, dissolved (μg/L as Hg)
Martinsburg	370	10- 3-78	650	0	30	10	0	4	20	0.1	0	3	0	1	1	4	1	0	<0.5
Martinsburg	378	10-16-78	260	0	—	30	50	2	30	.1	1	0	0	3	3	0	0	0	< .5
Martinsburg	499	10-16-78	980	0	—	160	790	200	30	.0	1	0	0	78	9	0	0	0	< .5
Pinesburg Station	552	9-19-78	44000	100	0	40	0	4	2	.0	4	2	0	0	2	2	0	0	< .5
Rockdale Run	223	9-24-57	—	—	—	—	40	—	—	—	—	—	—	—	0	—	—	—	—
Rockdale Run	539	9-19-78	210	0	0	20	20	2	7	.0	0	2	0	1	4	5	0	0	< .5
Stonehenge	505	9-19-78	260	0	0	30	70	0	0	.1	0	2	0	1	3	3	0	0	< .5
Stonehenge	525	9-20-78	430	0	0	50	150	2	2	.0	1	2	3	1	17	52	0	0	< .5
Elbrook	445	9-26-66	—	—	—	600	—	—	—	—	—	—	—	—	—	—	—	—	—
Elbrook	457	9-20-78	120	200	0	20	710	2	20	.0	0	1	0	1	4	8	0	0	2.4
Shadygrove	477	9-19-78	630	100	0	30	70	2	0	.0	1	2	0	1	1	4	0	0	< .5
Zullinger	421	7- 3-78	380	100	0	60	10	0	2	.1	3	0	2	0	1	3	0	0	< .5
Zullinger	471	9-20-78	230	0	0	40	10	1	0	.0	0	2	2	1	4	3	0	0	< .5
Tomstown	408	4-21-78	30	0	0	0	10	2	0	.1	1	0	0	0	2	3	0	0	< .5
Waynesboro	441	9-20-78	630	100	0	40	10	0	0	.1	0	2	1	1	6	5	0	0	< .5

most vulnerable to bacterial contamination. Presently, the shallow flow system in the carbonate rocks, especially down-gradient from existing communities, has been most affected by bacterial contamination.

Groundwater Flooding

Many areas in the carbonate valleys have shallow water levels. During periods of recharge in winter and spring, and during extraordinarily heavy precipitation, groundwater levels often rise to within a few feet of land surface or even above land surface. Subsurface structures such as basements, especiall, 'n low-lying areas, are flooded, causing water damage to the structures and their contents.

A residential area in the vicinity of Greencastle has been flooded by groundwater on numerous occasions. Other areas that have shallow water levels and a potential flooding problem were observed in farmlands along the west side of the main carbonate valley.

CONCLUSIONS

The carbonate-rock aquifer and the Martinsburg aquifer in the report area discharge an average of 800,000 (gal/d)/mi^2 and 480,000 (gal/d)/mi^2 of water, respectively, to streams. If only 25 percent of the discharge (a conservative estimate) were developed from widely spaced wells, 65 Mgal/d could be obtained from the carbonate aquifer and 32 Mgal/d from the Martinsburg aquifer without seriously affecting groundwater levels or streamflow. Locally, some stream reaches and groundwater levels could be affected more severely than is acceptable. These amounts are more than six times the total water use in 1979. Normally much of the water withdrawn is returned, thus further reducing adverse effects on the system.

Ideally located single wells in the carbonate aquifer are capable of sustained yields up to 500 gal/min from the Stonehenge Formation; 400 gal/min from the Zullinger Formation; 200 to 250 gal/min from the Waynesboro, Elbrook, Shadygrove, and Rockdale Run Formations; 150 to 200 gal/min from the St. Paul Group and Pinesburg Station Formation; at least 100 gal/min from the Tomstown Formation; and 40 gal/min from the Chambersburg Formation. Single wells in the Martinsburg aquifer are capable of sustained yields of 100 gal/min.

Sites located either in valleys or on fracture traces, or both, have the greatest potential for large-production wells. Significant interference effects in wells designed for large sustained yields can be avoided if the wells are spaced at least 1,000 feet apart and several thousand feet apart along the strike of bedding or known fracture zones.

Communities in the eastern two thirds of the main carbonate rock valley have the greatest potential for large-production wells. Communities should

be able to develop moderate supplies (50 to 100 gal/min) from any area underlain by the Martinsburg.

Iron, manganese, and hydrogen sulfide gas (smell of rotten eggs) derived from minerals in the Martinsburg may degrade an otherwise excellent supply of water. Calcium and magnesium deposits from water in the carbonate aquifer are undesirable for some industrial uses. Areas up-gradient from large-production wells should be protected from bacterial and chemical contaminants.

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TABLE 13. RECORD OF WELLS

Well location: The number that is assigned to identify the well. It is prefixed by a two-letter abbreviation of the county. The lat-long is the coordinates in degrees and minutes of the southeast corner of the 1-minute quadrangle within which the well is located.

Use: A, air conditioning; C, commercial; H, domestic; I, irrigation; N, industrial; P, public supply; R, recreation; S, stock; T, institution; U, unused.

Topographic setting: F, flat; H, hilltop; S, hillside; T, terrace; U, undulating; V, valley; W, draw; Z, other.

Aquifer: Qc, Colluvium; Om, Martinsburg Formation; Oc, Chambersburg Formation; Osp, Saint Paul Group; Ops, Pinesburg Station Formation; Orr, Rockdale Run Formation; Osh, Stonehenge Formation; Ost, Stoufferstown Formation; Csg, Shadygrove Formation, Czl, Zullinger Formation; Ce, Elbrook Formation; Cwb, Waynesboro Formation; Ct, Tomstown Formation.

Lithology: cg, conglomerate; dm, dolomite; gr, gravel; gwss, graywacke sandstone; ls, limestone; sd, sand; sh, shale; ss, sandstone.

Static water level: Date measured--month/last two digits of year.

Reported yield: gal/min, gallons per minute.

Specific capacity: (gal/min)/ft--gallons per minute per foot of drawdown; Rate (gal/min)--gallons per minute pumped during specific-capacity test.

Hardness: mg/L, milligrams per liter.

Specific conductance: Micromhos at 25°C, micromhos at 25 degrees Celsius.

TABLE 13.

Well location								
Number	Lat-Long	Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/lithology
Fr- 2	3959-7739	U. S. Government	Harrisburg's Kohl Bros.	1949	U	694	V	Osp/ls
3	3959-7739	do.	---	1950	U	640	S	Osp/ls
4	3959-7740	do.	---	---	U	645	S	Osp/ls
5	3959-7739	do.	Harrisburg's Kohl Bros.	---	U	685	S	Osp/ls
8	3956-7740	Memphis Equipment Co.	Rev. A. S. McCans	1958	N	620	V	Om/gwss
10	3955-7746	R. L. Hoffman	do.	1959	H	600	S	Om/sh
12	3957-7740	W. D. Ruby	do.	1958	H	720	S	Om/gwss
14	3958-7739	Dorothy Harper	do.	---	H	740	S	Om/sh
15	3959-7739	S. Jackson	do.	1958	H	690	S	Om/sh
16	3958-7739	Russell Auman	do.	1958	H	740	S	Om/sh
18	3958-7740	G. Hamman	do.	1954	H	620	S	Om/sh
19	3958-7739	Donald Foor	do.	1958	H	735	S	Om/sh
20	3957-7739	Harry Havernstock	do.	1959	H	685	H	Om/sh
22	3956-7741	G. S. McCleary	do.	1958	P	750	H	Om/gwss
23	3955-7742	William Byers	do.	---	H	744	S	Om/gwss
24	3957-7740	William Bowers	do.	---	H	680	S	Om/gwss
25	3954-7731	Greenwood Gospel Tabernacle	do.	---	H	890	S	Qc/---
27	3957-7735	Woodstock Orchard	do.	1958	H	710	V	Czl/ls
28	3959-7738	R. O. Hock	do.	1959	H	728	S	Oc/ls
30	3955-7747	David Bernecker	George E. Small	1958	H	676	V	Om/sh
31	3955-7747	John Malone	do	1957	H	655	S	Om/sh
32	3955-7747	Paul Higgins	do.	1957	H	670	S	Om/sh
34	3957-7742	Frank Wingert	do.	1957	H	680	H	Om/sh
35	3955-7747	Thomas Hoke	do.	1957	H	642	H	Om/sh
36	3955-7747	Kenneth Hockman	do.	1958	H	630	S	Om/sh
37	3955-7747	Herman Glass	do.	1958	H	670	S	Om/sh
38	3957-7742	Dan Bricker	do.	1957	H	683	H	Om/sh
39	3955-7740	N. J. Grove	do.	1959	H	640	S	Om/gwss
40	3955-7747	Lutheran Ch.	do.	1959	H	670	S	Om/sh
41	3955-7747	Paul Forman	do.	1959	H	645	S	Om/sh
42	3955-7747	Eichelberger	do.	1959	H	665	S	Om/sh
43	3955-7747	Bill Ferry	do.	1958	H	670	F	Om/sh
44	3955-7745	Carlton Heights Market	do.	---	H	630	S	Om/sh
45	3957-7747	Robert Strock	do.	1958	H	710	S	Osp/ls
46	3954-7747	Guy Johnston	do.	1958	H	676	V	Om/sh
47	3955-7747	Richard Hege	do.	1959	H	640	H	Om/sh
48	3955-7747	Dr. Cramer	do.	1959	H	760	S	Ce/ls
49	3955-7744	R. L. McClure	do.	1957	H	565	S	Om/sh
50	3955-7745	Alva Gordon	do.	1956	U	658	H	Om/sh
51	3956-7749	Richard Niswander	do.	1956	H	898	S	Osp/ls
52	3957-7740	Robert Colberg	do.	1958	H	736	S	Om/cg
53	3955-7745	Wilbur Fritz	do.	1959	H	650	H	Om/sh
55	3955-7747	Keller	do.	1957	H	685	S	Om/sh
56	3955-7747	Kake	do	1957	H	687	S	Om/sh
57	3955-7747	C. S. Amsley	do.	1960	H	656	H	Om/sh
58	3955-7745	do.	do	1959	H	650	H	Om/sh
59	3955-7745	Paul Morton	do.	1959	H	643	H	Om/sh
61	3955-7745	C. S. Amsley	do.	1960	H	650	H	Om/sh
62	3955-7745	Wengert	do.	1959	H	654	H	Om/sh
63	3955-7745	John Hopkins	do.	1959	H	656	H	Om/sh
64	3955-7742	Stone	do	1958	H	742	S	Om/sh
65	3947-7755	Elizabeth Grove	do.	1959	H	598	S	Orr/ls
66	3950-7754	Oaks Deshong	do	1957	H	617	S	Orr/ls
67	3951-7756	R. V. Bridendolph	do.	1958	H	758	S	Qc/gr
68	3949-7751	Thomas Fries	do.	1959	H	530	S	Osp/ls
69	3954-7749	Dan Shatzer	do.	1959	H	595	S	Oc/ls
70	3951-7747	Guy Meyers	do	1959	H	492	F	Om/sh
71	3953-7751	Chauncy Webster	do.	1957	H	595	S	Om/sh
72	3951-7751	Lemasters Community Center	do.	1957	P	582	F	Osp/ls
73	3952-7752	Russell Deavers	do.	1958	H	545	V	Om/sh
74	3951-7751	Lloyd Shatzer	do.	1957	H	575	F	Osp/ls
75	3951-7751	Harold Kriner	do.	1958	H	582	F	Osp/ls
76	3954-7748	H. Deshong	do.	1959	H	625	S	Om/sh
77	3950-7755	W. L. Grossnickle	do.	1957	H	685	S	Om/sh
78	3955-7747	E. E. Hartman	do.	1957	H	660	S	Om/sh
80	3950-7753	Jack Beck	do.	1956	H	540	S	Om/sh
81	3950-7751	Abram Meyers	do.	1959	H	543	F	Ops/dm
82	3951-7751	Lemasters Lutheran Ch.	do.	1959	H	585	F	Osp/ls
83	3952-7752	Raymond Dorty	do.	1958	H	575	F	Osp/ls
84	3951-7751	John Sollenburger	do.	1960	H	575	S	Ops/dm
85	3950-7749	Mennonite Ch.	do.	1960	H	552	S	Ops/dm
86	3950-7753	Hiram Hindbaugh	do.	1957	H	592	S	Osp/ls
87	3957-7747	J. H. Brechbill	Lloyd W. Piper	1958	H	645	S	Osp/ls
88	3945-7754	K. H. Atherton	do.	1958	H	628	S	Om/sh
89	3951-7749	John Hoffeditz	do	1949	H	595	S	Om/sh
91	3953-7750	Melvin Pugh	do.	1957	H	620	S	Orr/ls
92	3954-7738	Ralph Stauffer	do.	1956	H	682	F	Orr/ls
93	3951-7736	S. A. Walker	do.	1958	H	818	S	Ce/ls
94	3952-7739	D. E. Witherspoon	do.	1958	H	700	S	Orr/ls
95	3952-7739	J. R. McCulloh	do.	1958	H	680	S	Orr/ls
96	3953-7738	Carl Pugh	do.	1958	H	720	S	Csg/ls
97	3954-7744	Roy Plasterer	do.	1957	H	540	S	Om/sh
98	3958-7739	Silas Auman	do.	1958	H	740	F	Om/sh
101	3949-7740	A. L. Fulton	do.	1957	H	740	S	Czl/ls
102	3953-7731	R. J. MacEntire	do.	1957	H	893	F	Qc/sd

(CONTINUED)

Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gal/min)	Specific capacity ([gal/min]/ft)/rate (gal/min)	Hard-ness (mg/L)	Specific conduc-tance (micro-mhos at 25 C)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
441	60	6	---	48	5/49	11	1.00/11	---	---	---	Fr- 2
424	240	6	---	70	---	50	0.56/50	---	---	---	3
---	---	---	---	39	9/50	---	---	---	---	---	4
425	---	5	---	52	---	50	---	---	---	---	5
119	23	6	---	23	---	40	6.6/40	103	240	8.4	8
72	20	6	---	18	---	40	---	---	---	---	10
53	20	6	---	18	---	18	---	188	460	---	12
55	22	6	---	22	---	42	---	86	230	---	14
104	---	6	---	40	---	30	---	51	90	---	15
70	23	6	32;70	20	---	40	---	103	270	---	16
102	20	6	---	18	---	5	---	137	370	8.1	18
57	20	6	---	20	---	42	---	86	220	---	19
122	20	6	---	40	---	12	0.17/12	---	285	7.4	20
138	25	6	---	50	---	40	5.0/40	120	205	---	22
62	19	6	---	23	---	42	---	---	---	---	23
45	24	6	---	15	---	42	---	---	---	---	24
96	96	6	---	70	---	5	0.19/5	---	---	---	25
37	36	6	---	11	---	42	21/42	---	---	---	27
178	---	6	---	80	---	20	0.40/20	272	370	---	28
50	39	6	40;50	25	---	25	1.7/25	---	---	---	30
80	15	6	30;78	15	---	25	---	---	---	---	31
55	38	6	40;52	30	---	25	5.0/25	---	380	7.5	32
90	27	6	35;85	25	---	25	0.70/25	---	---	---	34
60	22	6	38;55	20	---	25	1.2/25	---	760	7.5	35
110	15	6	40;110	18	---	21	5.2/21	---	---	---	36
65	28	6	35;62	9	---	6	---	---	---	---	37
85	24	6	35;82	35	---	25	4.1/25	137	270	7.6	38
68	16	6	55;68	30	---	20	2.8/20	---	---	---	39
120	21	6	90;115	35	---	6	---	---	---	---	40
70	17	6	50;70	20	---	10	---	---	---	---	41
70	20	6	50;68	30	---	15	---	---	---	---	42
50	12	6	35;55	20	---	20	1.3/20	325	---	---	43
60	---	6	45;60	18	---	30	7.5/30	---	---	---	44
130	59	6	90;130	49	---	20	---	---	---	---	45
60	25	6	35;58	25	---	10	---	---	---	---	46
40	18	6	25;40	---	---	20	---	---	---	---	47
230	57	6	105;200	60	---	1	---	---	---	---	48
45	24	6	38;43	20	---	25	5.0/25	---	---	---	49
50	25	6	30;45	20	---	4	0.13/4	---	---	---	50
105	22	6	65;105	35	---	---	0.03/---	256	700	7.5	51
50	20	6	30;48	8	---	---	---	137	240	---	52
55	26	6	30;55	---	---	15	---	---	---	---	53
45	19	6	30;38;45	2	---	25	2.5/25	---	---	---	55
34	34	6	---	6	---	25	---	---	---	---	56
40	---	6	30;40	20	---	10	---	---	---	---	57
55	17	6	30;50	30	---	20	---	---	---	---	58
70	19	6	50;60	30	---	20	---	---	---	---	59
60	19	6	45;60	25	---	20	---	---	---	---	61
45	27	6	35;43	10	---	20	0.80/20	---	---	---	62
55	25	6	30;50	25	---	10	---	---	---	---	63
65	28	6	30;60	20	---	25	0.70/25	51	105	8.3	64
65	31	6	35;60	25	---	20	---	---	---	---	65
140	21	6	40;138	30	---	1	0.03/1	---	---	---	66
80	80	6	---	25	---	25	0.80/25	---	---	---	67
75	14	6	51;72	30	---	20	---	---	---	---	68
40	21	6	35	28	---	20	---	342	550	7.6	69
45	19	6	30;45	20	---	20	5.0/20	---	---	---	70
60	23	6	55	25	---	10	---	---	---	---	71
104	6	6	70;102	51	---	6	---	---	---	---	72
50	18	6	35;50	14	---	25	6.2/25	120	200	7.4	73
94	14	6	60;92	30	---	5	0.08/5	---	800	7.1	74
155	22	6	35;60	30	---	4	0.03/4	---	---	---	75
70	13	6	40;65	40	---	20	2.2/20	---	---	---	76
100	25	6	---	---	---	25	0.63/25	68	1050	7.0	77
50	24	6	35;48	10	---	---	---	---	---	---	78
165	30	6	35;90;130	30	---	1	---	---	---	---	80
160	16	6	160	35	---	---	---	291	625	---	81
85	30	6	35;60;85	35	---	25	---	---	---	---	82
55	13	6	38	30	---	21	---	---	---	---	83
98	8	6	98	45	---	20	---	239	650	7.7	84
64	24	6	64	40	---	20	---	---	---	---	85
185	12	6	40;130;180	35	---	1	---	342	800	7.2	86
143	18	6	40;143	20	---	16	4.0/16	205	360	7.8	87
70	30	6	40;60	10	---	20	6.6/20	---	---	---	88
437	20	6	---	---	---	---	---	---	---	---	89
320	10	6	18;150;320	14	---	16	0.36/16	---	---	---	91
66	7	6	---	12	---	16	5.3/16	---	---	---	92
202	58	6	40;100	40	---	6	0.04/6	---	---	---	93
604	18	6	50;70;604	25	---	18	0.12/18	---	300	6.0	94
142	20	6	93;130	20	---	16	0.50/16	222	360	---	95
120	92	6	115	20	---	18	4.5/18	---	---	---	96
120	97	6	60;120	15	---	16	5.3/16	34	280	8.8	97
70	36	6	20;35;65	15	---	20	6.6/20	---	---	---	98
88	45	6	42;65;88	35	---	12	0.30/12	205	370	---	101
105	99	6	---	30	---	20	4.0/20	---	---	---	102

TABLE 13.

Well location		Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat-Long							
Fr-103	3958-7735	Wilbur Warne	Lloyd W. Piper	1957	H	665	S	Qc/sd
104	3959-7734	A. L. Byers	do.	1957	H	750	S	Csg/ls
105	3943-7736	E. S. Martin	do.	1958	H	600	S	Czl/ls
107	3954-7732	Hoirs Golf Range	Ira F. Rock	1958	C	843	F	Qc/sd
108	3954-7730	M. B. Lenard	do.	1958	H	920	V	Ct/dm
109	3951-7733	J. Karper	do.	---	H	964	H	Ct/dm
111	3953-7735	W. Elvey	do.	1960	H	798	F	Ce/ls
112	3953-7734	Laban Wingert	do.	1960	H	823	F	Ce/ls
114	3948-7734	Hugh Hardie	do.	1958	H	740	S	Ce/ls
116	3944-7741	Irvin Horst	William E. Martin	1957	H	695	V	Osh/ls
117	3945-7740	Walter Barr	do.	1958	H	790	S	Czl/ls
118	3951-7741	Martin Mellinger	do.	1960	H	616	F	Oc/ls
119	3948-7738	S. H. Kuhn	do.	1958	H	780	S	Czl/ls
120	3946-7739	Adin Horst	do.	1956	H	750	S	Czl/ls
121	3946-7739	do.	do.	1956	H	725	S	Czl/ls
122	3946-7739	do.	do.	1960	H	730	S	Czl/ls
123	3950-7742	Wayne Gas and Oil Co.	Ira F. Rock	1957	C	588	S	Oc/ls
124	3943-7734	Daniel Miller	William E. Martin	1958	H	640	S	Ce/ls
125	3943-7742	Mrs. Dougherty	Joseph Hoffman	1959	H	715	S	Orr/ls
126	3948-7740	Grace Henneberger	do.	1959	H	758	S	Csg/ls
127	3947-7742	Donald Myers	do.	1959	H	643	S	Orr/ls
128	3951-7754	James Buchanan Sch.	Harrisburg's Kohl Bros.	1953	T	600	S	Orr/ls
129	3951-7754	do.	do.	1953	T	600	S	Orr/ls
130	3946-7750	Marrell Dumeny	Joseph Hoffman	---	H	460	V	Osp/ls
131	3947-7750	William Docherty	do.	1960	H	494	S	Orr/ls
132	3948-7749	O. O. Byers	do.	1959	H	542	S	Osp/ls
134	3954-7730	John Smith	Ira F. Rock	1959	H	880	S	Ct/dm
135	3958-7734	Glenn Shank	Concrete Products Co.	1960	H	716	S	Qc/gr
136	3957-7739	Norman Eyer	do.	1960	H	720	S	Om/sh
137	3951-7741	Martin Mellinger	---	---	---	617	F	Oc/ls
138	3953-7740	L. B. Everett	Ralph E. Robison	---	A	640	F	Oc/ls
139	3953-7740	do.	do.	1957	H	640	F	Oc/ls
140	3956-7738	Shively's Dairy	Rev. A. S. McCans	---	N	640	H	Osp/ls
141	3951-7742	Charles Farren	Ralph E. Robison	1959	H	595	F	Oc/ls
142	3948-7750	Conrad Guss	do.	1958	H	510	S	Orr/ls
143	3954-7740	Dinner Bell Restaurant	do.	---	C	617	F	Orr/ls
144	3954-7740	M. L. Gift	do.	---	H	625	S	Orr/ls
145	3954-7740	Robert Nitterhouse	do.	1960	H	617	F	Orr/ls
146	3950-7740	Shull High	do.	1960	H	750	S	Czl/ls
147	3949-7742	Vernon Widder	do.	1960	H	638	S	Orr/ls
148	3947-7742	N. L. Snively	do.	1960	H	662	S	Orr/ls
149	3955-7742	Richard Rockwell	do.	1960	H	752	F	Om/gwss
150	3955-7741	R. S. Harry	do.	1959	H	750	S	Om/gwss
151	3950-7739	A. M. Richards	do.	1959	H	785	S	Czl/ls
153	3955-7743	Nelson Runyon	do.	1959	H	640	S	Om/sh
154	3958-7740	Jack Cook	K. R. Whisler	1959	S	760	H	Om/gwss
155	3949-7739	Donald McClure	Ralph E. Robison	---	H	800	S	Czl/ls
157	3952-7751	Fred Martin	George E. Small	1958	H	575	F	Osp/ls
161	3957-7745	Glenn Bricker	do.	1959	H	683	H	Om/sh
162	3957-7741	Katie Bricker	do.	1959	H	700	S	Om/sh
169	3949-7752	James Varden	Ira F. Rock	1957	H	530	S	Om/sh
170	3954-7741	Fred Witters	do.	1959	H	620	S	Om/sh
171	3955-7738	David Bigler	do.	1958	H	650	F	Orr/ls
173	3951-7751	William Heckman	Jerry Provard	1958	H	578	S	Ops/dm
174	3946-7754	E. J. Woodring	do.	1958	H	520	V	Om/sh
177	3952-7741	O. E. Kalbflesh	do.	1958	H	630	F	Osp/ls
178	3948-7748	Bahner Fitz	do.	---	H	605	F	Om/sh
179	3947-7750	Paul Carbaugh	do.	1958	H	480	V	Orr/ls
180	3947-7750	Russell Meyers	do.	1958	H	490	V	Orr/ls
183	3946-7754	Winfield Thomas	do.	1958	H	602	S	Om/sh
186	3945-7742	W. C. Heacox	do.	1958	S	762	S	Orr/ls
187	3943-7747	Oakey Bohon	do.	1958	H	545	S	Om/gwss
189	3953-7753	L. E. Stahl	George E. Small	1958	H	665	S	Om/sh
190	3953-7753	G. L. Zeger	do.	1958	H	665	S	Om/sh
192	3950-7753	Jack Beck	do.	1957	H	543	S	Om/sh
193	3946-7741	Ross Zeger	do.	1960	H	735	S	Osh/ls
194	3949-7743	Raymond Eberly	do.	1959	H	583	H	Om/sh
195	3949-7743	do.	do.	1958	H	580	H	Om/sh
196	3956-7740	O. R. Miller	do.	1959	H	630	V	Om/gwss
198	3949-7754	Clarence Filer	do.	1960	I	567	S	Orr/ls
200	3956-7740	H. W. Ott	do.	1956	R	650	H	Om/sh
201	3950-7751	Raymond Shelly	do.	1958	H	530	F	Osp/ls
202	3953-7742	Camp Robinhood	Ralph E. Robison	1958	R	640	S	Om/gwss
203	3952-7754	Anthony Martin	George E. Small	1956	H	655	S	Om/sh
204	3953-7742	Camp Robinhood	---	1925	P	660	H	Om/gwss
205	3952-7754	M. A. Dicker	George E. Small	1957	H	660	H	Om/sh
206	3953-7742	Camp Robinhood	---	1930	P	650	S	Om/gwss
207	3949-7754	Mercersburg Bor.	Ralph E. Robison	1957	P	645	S	Om/sh
209	3949-7754	Mercersburg Academy	---	---	T	617	S	Om/sh
210	3957-7741	Guy Brechbill	Rev. A. S. McCans	1947	H	718	S	Om/sh
211	3949-7754	Mercersburg Academy	Ralph E. Robison	1967	T	617	S	Om/sh
212	3954-7742	South Hamilton Sch.	Rev. A. S. McCans	---	P	750	S	Om/gwss
213	3954-7753	C. E. Bernecker	George E. Small	1957	H	610	F	Om/sh
214	3955-7742	G. W. Thrush	do.	1949	H	700	H	Om/gwss
215	3955-7754	Lawrence Newman	do.	1958	H	662	S	Om/sh

(CONTINUED)

Total depth below land surface (feet)	Casing: Depth (feet)	Casing: Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity ([gal/min]/ft) rate (gal/min)	Hardness (mg/L)	Specific conductance (micromhos at 25°C)	pH	Well number
46	43	6	---	6	---	30	10.0/30	---	---	---	Fr-103
296	60	6	120;296	40	---	16	0.80/16	---	---	---	104
110	60	6	105;296	20	---	20	6.6/20	---	---	---	105
260	260	6	---	30	---	15	0.08/15	---	---	---	107
100	52	6	20	20	---	10	1.00/10	---	---	---	108
232	98	6	160	---	---	6	0.04/6	---	---	---	109
116	22	6	---	98	---	---	---	---	---	---	111
92	28	6	---	20	---	7	0.35/7	---	---	---	112
75	38	6	75	50	---	10	1.00/10	---	---	---	114
102	15	6	92;100	15	---	20	5.0/20	---	---	---	116
300	12	6	13;85;155;292	45	---	14	0.07/14	---	755	7.5	117
225	49	6	---	25	---	1	0.03/1	---	---	---	118
393	9	6	15;52;86; 102;117;130	20	---	5	0.08/5	291	440	---	119
66	6	6	---	28	---	4	0.13/4	---	---	---	120
151	15	6	148	7	---	10	0.20/10	---	---	---	121
70	15	6	---	14	---	30	7.5/30	---	---	---	122
205	12	6	70	---	---	6	---	---	---	---	123
100	7	6	41;56;98	28	---	18	2.0/18	---	---	---	124
101	23	6	---	30	---	6	---	---	---	---	125
225	2	6	---	40	---	5	0.03/5	---	---	---	126
245	13	6	---	50	---	5	0.03/5	274	460	---	127
227	46	6	---	9	---	106	0.70/106	---	---	---	128
390	---	---	---	30	---	1	---	---	---	---	129
85	32	6	---	30	---	6	0.13/6	---	440	7.7	130
121	6	6	---	40	---	10	---	393	1100	7.1	131
165	15	6	---	20	---	1	0.03/1	308	1000	7.4	132
125	83	6	70;125	25	---	5	0.10/5	---	---	---	134
80	76	6	---	40	---	25	---	---	---	---	135
77	21	6	47;60	---	---	10	---	---	---	---	136
30	---	---	---	25	---	1	---	308	780	---	137
70	---	6	---	---	---	15	---	---	---	---	138
300	62	6	---	70	---	10	---	256	410	---	139
265	---	---	---	60	---	50	---	---	---	---	140
120	10	6	80;118	20	---	40	4.0/40	---	---	---	141
395	125	6	122	---	---	---	---	---	---	---	142
116	21	6	40;70;85;114	18	---	30	1.4/30	---	---	---	143
130	17	6	130	30	---	12	0.30/12	---	---	---	144
105	42	6	105	60	---	30	6.0/30	239	410	---	145
92	35	6	92	40	---	15	0.40/15	---	---	---	146
200	21	6	90;120;180; 196	30	---	15	0.20/15	---	---	---	147
43	32	6	43	18	---	18	2.6/18	---	---	---	148
65	19	6	65	30	---	15	0.70/15	68	105	8.1	149
80	26	6	80	14	---	22	0.85/22	68	130	7.0	150
50	11	6	---	35	---	25	5.0/25	---	---	---	151
80	20	6	80	15	---	15	0.40/15	86	155	8.0	153
125	13	6	---	8	---	35	---	308	490	---	154
150	17	6	---	20	---	20	2.0/20	---	---	---	155
45	15	6	45	28	---	21	3.5/21	325	950	---	157
55	26	6	35;55	25	---	20	2.8/20	---	---	---	161
50	20	6	30;50	25	---	20	2.8/20	---	---	---	162
60	55	6	40	---	---	5	---	---	---	---	169
70	19	6	---	---	---	---	---	120	150	8.5	170
40	22	6	---	20	---	5	1.00/5	---	---	---	171
80	15	6	68;80	15	---	1	---	308	850	7.3	173
46	22	6	35;40	8	---	20	2.0/20	---	---	---	174
43	15	6	43	20	---	20	---	---	---	---	177
55	22	6	45	15	---	20	1.5/20	---	---	---	178
128	12	6	100	9	---	2	---	239	650	7.4	179
57	21	6	27;43	18	---	25	13/25	---	---	---	180
44	16	6	40	6	---	20	0.90/20	---	---	---	183
125	12	6	---	---	---	1	---	---	450	7.6	186
42	22	6	32;52	20	---	15	3.0/15	---	---	---	187
90	35	6	60;85	30	---	25	---	---	---	---	189
122	115	6	---	28	---	25	---	---	---	---	190
65	20	6	---	15	---	10	---	120	300	---	192
34	6	6	32	19	---	20	---	---	---	---	193
140	25	6	---	30	---	---	0.04/---	---	---	---	194
67	27	6	50;65	29	---	7	---	---	---	---	195
50	24	6	38;45	---	---	10	---	---	---	---	196
145	25	6	60;123;144	40	---	10	---	---	---	---	198
90	15	6	25;70;90	20	---	10	0.28/10	---	---	---	200
104	12	6	---	25	---	1	0.01/1	274	900	7.3	201
250	14	8	185	3	---	23	0.10/23	---	---	---	202
80	24	6	35;70;78	18	---	15	---	239	550	7.3	203
100	---	8	---	---	---	10	---	---	---	---	204
85	31	6	40;62;84	35	---	10	0.10/10	---	---	---	205
100	---	8	---	1	---	20	---	---	---	---	206
200	35	8	---	21	---	---	5.9/320	---	---	---	207
80	---	6	---	14	4/60	20	---	---	---	---	209
70	---	6	---	25	---	25	---	---	180	8.2	210
100	24	6	---	15	4/60	45	7.6/53	---	---	---	211
104	---	6	---	70	---	---	---	120	205	8.6	212
55	35	6	30;52	5	---	20	---	---	---	---	213
70	20	6	---	15	---	---	---	---	---	---	214
75	50	6	60;75	28	---	25	---	---	---	---	215

TABLE 13.

Well location		Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat-Long							
Fr-216	3958-7744	Portico Sch.	---	1950	P	660	S	Om/sh
217	3952-7736	Ralph Deardoff	Ralph E. Robison	---	H	800	S	Czl/ls
218	3952-7736	do.	do.	---	H	800	S	Czl/ls
219	3950-7743	Dixie Motel	do.	---	P	610	S	Oc/ls
220	3950-7743	do.	do.	1960	P	600	S	Oc/ls
221	3950-7742	do.	do.	1952	P	588	S	Oc/ls
222	3949-7743	Castle Motel	do.	---	P	563	F	Osp/ls
223	3945-7742	U. S. Army	do.	1952	A	690	F	Orr/ls
226	3953-7734	Donald Elvey	Ira F. Rock	1957	H	805	F	Ce/ls
227	3948-7734	E. U. B. Orphanage	---	1908	P	700	S	Ce/ls
231	3959-7736	P. F. Peters	Samuel F. Shuman	1956	P	678	F	Orr/ls
232	3959-7736	Walter Ramsey	do.	1955	P	678	F	Orr/ls
233	3959-7736	do.	do.	1955	P	678	F	Orr/ls
234	3959-7736	Robert Elser	Rev. A. S. McCans	1952	P	678	F	Orr/ls
235	3959-7736	do.	do.	1950	P	682	S	Orr/ls
236	3958-7735	Norman Wadel	---	---	H	705	S	Czl/ls
237	3950-7739	J. M. Murray	Ralph E. Robison	1959	H	800	S	Czl/ls
238	3946-7741	Shady Grove Elementary Sch.	---	1954	P	788	F	Orr/ls
239	3946-7740	Grove Manufacturing Co.	Ralph E. Robison	1951	N	802	F	Csg/ls
240	3946-7739	Alfred Zeger	---	1955	H	781	S	Czl/ls
241	3954-7740	Giltz White	Ralph E. Robison	1953	H	625	S	Osp/ls
242	3956-7737	P. M. Nolt	Rev. A. S. McCans	1960	H	705	S	Orr/ls
243	3957-7737	R. I. Sleighter	---	---	H	705	S	Orr/ls
244	3956-7738	S. S. Diller	---	1969	H	655	F	Osp/ls
245	3951-7742	R. E. Robison	Ralph E. Robison	1955	H	600	V	Oc/ls
246	3951-7742	do.	do.	1958	R	585	S	Oc/ls
247	3950-7743	Dixie Motel	---	1947	P	608	S	Om/sh
248	3946-7738	C. F. Miller	---	1918	H	701	S	Czl/ls
249	3946-7737	do.	Ralph E. Robison	---	S	763	S	Czl/ls
250	3943-7743	E. L. Leckron	do.	1960	H	715	F	Orr/ls
251	3949-7754	Loewengart and Co.	---	1946	N	538	V	Osp/ls
252	3948-7743	American Stores Abattoir	William E. Martin	1959	N	570	V	Osp/ls
253	3948-7743	do.	Harrisburg's Kohl Bros.	1958	N	570	V	Osp/ls
254	3951-7751	Paul Maun	George E. Small	1960	H	580	F	Oc/ls
256	3958-7746	Paul Myers	Rev. A. S. McCans	1956	H	670	S	Om/sh
257	3954-7740	Roselawn Motel	Ralph E. Robison	1950	P	612	F	Orr/ls
258	3947-7749	Montgomery Elementary Sch.	O. W. Sunday	1957	P	625	F	Om/sh
264	3953-7749	Jim Shire	Rev. A. S. McCans	1959	H	610	F	Osp/ls
266	3955-7746	R. L. Hoffman	do.	1959	H	600	S	Om/sh
267	3955-7747	Thurman Finniff	do.	---	H	670	S	Om/sh
268	3957-7745	Lloyd Amsley	do.	1957	H	860	S	Oc/ls
269	3955-7745	P. H. Kunkle	do.	---	H	635	S	Om/sh
270	3955-7745	Lester Peckman	do.	1959	H	620	S	Om/sh
271	3958-7746	Paul Myers	do.	1946	H	660	S	Om/sh
272	4005-7748	Ivan Ehman	---	---	P	840	V	Osp/ls
273	4003-7749	Fannettsburg Elementary Sch.	---	1945	P	860	H	Om/sh
275	3959-7753	R. W. North	George E. Small	1960	H	715	S	Osp/ls
276	3956-7754	Walter Malone	do.	1954	P	710	S	Om/sh
291	4000-7731	John Wadel	Eldon E. Funk	1973	P	885	H	Ce/ls
293	3955-7744	A. E. Martin	---	1942	H	560	T	Om/sh
294	4009-7747	M. W. Shatzer	Martin W. Shatzer	1960	H	1060	S	Om/sh
295	3950-7748	Wayne Cleaver	---	---	H	560	S	Om/sh
297	3950-7748	Bethlehem Steel	Martin W. Shatzer	1964	H	565	H	Om/sh
299	3950-7748	do.	---	---	H	590	S	Om/sh
300	3950-7748	do.	---	---	H	565	S	Om/sh
301	3950-7748	do.	---	---	H	540	S	Osp/ls
305	3951-7747	Parker Barnes	---	---	H	480	V	Om/sh
307	3951-7747	James Pence	---	---	H	490	V	Om/sh
308	3950-7747	Huntington Creek Corp.	Ralph E. Robison	1964	U	525	V	Om/sh
309	3950-7748	Elizabeth Frank	Rev. A. S. McCans	1964	H	520	S	Osp/ls
310	3950-7747	Huntington Creek Corp.	Ralph E. Robison	1964	N	525	V	Om/sh
311	3950-7748	Victor Burkholder	---	---	H	490	V	Om/sh
312	3951-7747	Lawson Leasure	---	---	H	530	V	Om/sh
315	3951-7747	Harvey Acker	---	---	S	520	S	Osp/ls
316	3951-7748	H. A. Meyers	Ralph E. Robison	1967	H	545	S	Om/sh
317	3951-7748	do.	Harrisburg's Kohl Bros.	1967	H	545	S	Om/sh
318	3951-7748	do.	---	---	S	550	S	Om/sh
319	3951-7748	Donald Statler	---	---	H	500	V	Osp/ls
321	3951-7748	Lenord Gelsinger	Ralph E. Robison	---	H	540	H	Oc/ls
323	3951-7747	Ronald Hampton	---	---	H	520	H	Osp/ls
324	3951-7748	Robert Barnes	---	1967	U	540	H	Oc/ls
325	3951-7748	do.	Ralph E. Robison	1967	H	540	H	Oc/ls
328	3951-7741	Guilford Water Authority	Eldon E. Funk	1974	U	640	V	Orr/ls
330	3946-7733	J. A. Hess	David W. Pool	1966	U	770	S	Ct/dm
332	3947-7741	Greencastle Bor.	Harrisburg's Kohl Bros.	1964	U	730	S	Osh/ls
333	3949-7742	Pa. Dept. of Transp.	do.	1975	U	610	V	Orr/ls
334	3949-7742	do.	do.	1975	U	610	V	Orr/ls
335	3947-7741	Greencastle Bor.	---	---	U	730	S	Osh/ls
336	3947-7741	do.	Ralph E. Robison	---	P	760	V	Ost/ls
337	3947-7741	do.	---	---	U	740	V	Ost/ls
338	3947-7741	do.	---	---	U	745	V	Ost/ls
339	3947-7743	do.	Ralph E. Robison	1966	U	622	S	Orr/ls

(CONTINUED)

Total depth below land surface (feet)	Casing: Depth (feet)	Casing: Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity ([gal/min]/ft)/rate (gal/min)	Hardness (mg/L)	Specific conductance (micromhos at 25°C)	pH	Well number
85	---	---	---	---	---	10	2.3/10	---	---	---	Fr-216
374	---	---	---	35	---	1	---	---	---	---	217
250	---	6	---	40	---	1	---	---	---	---	218
250	20	6	150	6	---	10	0.04/10	---	---	---	219
200	---	---	---	---	---	5	---	---	---	---	220
160	3	6	---	13	---	18	0.17/18	256	---	---	221
95	---	6	92	35	---	20	---	359	680	7.6	222
130	25	6	40;127	18	---	165	---	---	---	---	223
54	15	6	---	19	---	6	0.75/6	---	---	---	226
238	---	---	---	18	---	60	20/60	120	---	---	227
87	11	6	30;83	35	---	30	4.3/30	---	560	7.3	231
125	---	---	---	20	---	20	4.0/20	---	---	---	232
100	---	6	---	20	---	20	4.0/20	---	---	---	233
200	15	6	---	18	---	30	5.0/30	---	650	7.3	234
100	14	6	---	---	---	30	---	---	---	---	235
62	---	---	---	40	---	10	---	---	---	---	236
50	20	6	---	12	---	---	---	---	---	---	237
245	---	---	---	40	---	10	---	---	1000	7.1	238
115	60	6	---	70	---	20	5.0/20	---	---	---	239
76	20	6	---	50	---	25	2.5/25	---	---	---	240
130	30	6	---	---	---	30	---	---	---	---	241
171	19	6	80;125;171	65	---	14	---	---	---	---	242
160	---	6	---	100	---	1	---	---	---	---	243
42	---	---	---	32	---	26	---	---	725	7.3	244
85	15	6	40	16	---	7	---	---	530	7.5	245
160	12	6	120	8	4/60	7	0.05/7	---	---	---	246
187	---	---	---	25	---	15	---	---	---	---	247
175	10	6	80;175	40	---	5	---	---	---	---	248
294	1	6	---	40	---	10	---	---	---	---	249
170	20	6	70;170	40	---	25	3.1/25	---	---	---	250
168	---	12	---	10	---	225	10.0/225	---	---	7.2	251
650	10	8	58;100;117;244;339;397;536	45	---	43	0.21/43	---	---	---	252
250	20	8	60;65	63	---	40	---	---	---	---	253
72	16	6	55;65;72	27	---	20	0.70/20	---	---	---	254
59	26	6	---	20	---	50	---	205	335	7.7	256
55	38	6	25	---	---	8	---	239	330	---	257
183	40	8	160	35	---	100	1.8/100	---	---	---	258
106	31	6	---	32	---	42	7.0/42	---	---	---	264
72	20	6	---	18	---	42	5.7/42	---	---	---	266
47	20	6	---	12	---	18	---	---	---	---	267
31	28	6	---	11	---	5	---	---	300	7.7	268
72	21	6	---	30	---	42	8.4/42	---	---	---	269
77	14	6	---	18	---	40	5.7/40	---	---	---	270
162	28	6	34	30	---	5	0.05/10	205	510	---	271
94	---	---	---	37	---	---	---	---	---	---	272
85	---	6	---	---	---	---	---	---	---	---	273
52	22	6	---	28	---	25	---	---	---	---	275
35	30	6	---	15	---	20	---	---	---	---	276
396	125	---	---	108	5/73	67	5.4/67	---	---	---	291
50	---	---	---	3	4/68	---	---	---	---	---	293
130	70	6	---	20	4/68	---	---	---	---	---	294
30	---	8	---	1	6/69	---	---	188	---	8.0	295
105	---	6	---	---	---	---	---	188	---	7.9	297
100	---	---	---	---	---	---	---	427	---	7.2	299
---	---	---	---	---	---	---	---	103	---	7.3	300
---	---	---	---	---	---	---	---	359	---	7.2	301
---	---	---	---	---	---	---	---	17	---	7.4	305
18	---	48	---	17	6/69	---	---	205	---	7.4	307
200	---	---	---	4	6/69	---	---	---	---	---	308
103	---	---	---	30	---	---	---	359	---	7.0	309
300	---	---	---	---	---	55	---	---	---	---	310
77	---	8	---	10	---	---	---	462	---	7.2	311
12	---	---	---	7	6/69	---	---	---	---	---	312
---	---	---	---	---	---	---	---	308	---	7.2	315
22	---	---	---	18	1/67	10	---	---	---	---	316
97	---	---	25	---	---	10	---	---	---	---	317
32	---	---	---	14	6/69	---	---	---	---	---	318
14	---	---	---	---	---	---	---	342	---	7.7	319
150	---	---	---	---	---	---	---	445	---	7.0	321
100	---	---	---	30	---	---	---	445	---	---	323
200	---	---	---	36	6/69	---	---	---	---	---	324
300	---	---	---	---	---	---	---	359	---	7.4	325
500	65	8	105;171;351	8	---	150	0.60/150	---	---	---	328
260	21	6	---	52	3/75	---	---	---	---	---	330
296	92	8	93;110	22	3/75	5	0.13/5	256	522	---	332
403	50	8	---	2	3/75	1	---	---	---	---	333
341	50	---	110;230	2	2/75	3	0.03/3	---	---	---	334
133	---	---	---	21	3/75	---	---	---	---	---	335
150	---	15	---	8	3/75	350	154/350	---	---	---	336
44	---	6	---	7	3/75	---	---	---	---	---	337
248	---	6	---	3	3/75	---	0.14/9	---	---	---	338
233	11	6	---	4	3/75	---	---	---	---	---	339

TABLE 13.

Well location: Number	Well location: Lat-Long	Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/lithology
Fr-340	3947-7743	Greencastle Bor.	---	---	U	599	V	Orr/ls
341	3947-7742	do.	---	---	U	595	S	Orr/ls
342	3949-7742	Pa. Dept. of Transp.	Harrisburg's Kohl Bros.	---	P	650	S	Orr/ls
351	3949-7742	do.	do.	1975	U	650	S	Orr/ls
352	3956-7744	Kenneth Mackey	Paul C. Ramer	1975	H	561	S	Om/sh
353	3955-7746	Hillside Manor Mobile Home Park	---	---	U	642	S	Om/sh
354	3955-7744	D. Greenwood	---	---	U	585	S	Om/sh
355	4000-7739	Letterkenny Army Depot	---	---	U	735	U	Om/sh
356	4001-7739	do.	---	---	U	694	S	Om/sh
357	4002-7743	do.	---	---	U	743	F	Om/sh
358	4000-7742	do.	---	---	U	639	S	Om/sh
359	3957-7742	do.	---	---	H	680	H	Om/sh
360	4000-7745	Charles Eberly	---	---	U	650	S	Oc/sh
361	3959-7745	Amos Bricker	Rev. A. S. McCans	1962	H	605	V	Osp/ls
362	3959-7745	Clarence Burkholder	---	1942	H	670	S	Om/sh
363	3956-7744	Wilber Mackey	Ray R. Toms, Jr.	1976	H	560	S	Om/sh
364	3958-7741	Bear Valley Water Authority	---	---	U	747	H	Om/sh
365	3956-7741	Farmers & Merchants Trust	---	---	S	741	H	Om/gwss
366	3958-7747	Gerald Martin	---	---	U	825	S	Osp/ls
367	3956-7745	Maude Fague	---	---	H	670	H	Om/sh
368	3956-7747	R. Fustings	---	---	H	680	U	Om/sh
369	3956-7747	Oliver Heisey	---	1973	H	715	S	Om/sh
370	3956-7746	Ken Meyers	---	---	H	670	S	Om/sh
371	3953-7743	Omar Nicarry	Paul C. Ramer	1973	H	682	S	Om/gwss
372	3954-7743	Chester Nicarry	---	---	S	655	W	Om/gwss
373	3955-7743	Charles Meyers	---	---	H	700	H	Om/gwss
374	3956-7742	Farmers Produce	---	---	U	725	W	Om/gwss
375	3954-7745	Rolling Acres Mobile Home Park	---	---	U	645	H	Om/sh
376	3957-7749	Frederick Waite	---	---	U	905	S	Oc/ls
377	3959-7740	Letterkenny Army Depot	---	---	U	635	V	Osp/ls
378	3956-7743	Peter Devos	---	---	H	661	H	Om/sh
379	3957-7744	Herbert Dice	---	---	H	575	S	Om/sh
380	3958-7744	Fred Meyers	---	---	U	625	S	Om/sh
381	3958-7744	Myron Young	---	---	H	640	S	Om/sh
382	3957-7748	Baker General Store	---	---	U	780	S	Ops/dm
383	3957-7742	Upper Strasburg Mennonite Ch.	---	---	H	679	H	Om/sh
384	3952-7755	Mt. Parnell Fisheries	Moody Drilling Co., Inc.	1977	U	682	V	Ops/dm
385	3952-7755	do.	do.	1977	U	681	V	Orr/ls
386	3956-7734	Ruben Eberly	Ray R. Toms, Jr.	1965	H	735	V	Ce/ls
387	3955-7734	Kenneth Martin	do.	1976	H	739	F	Ce/ls
388	3952-7734	Alvan Brechbill	Ralph E. Robison	1971	H	840	F	Ce/ls
389	3951-7735	do.	Ray R. Toms, Jr.	1973	H	878	S	Ce/ls
390	3958-7732	Ralph Scott	Eldon E. Funk	1975	H	865	S	Cwb/ss
391	3954-7737	Falling Springs Elementary Sch.	---	---	T	705	S	Orr/ls
392	3952-7738	New Franklin Elementary Sch.	---	---	C	760	S	Czl/ls
393	3951-7742	Frank Shew	Lester E. Funk	1977	C	610	F	Oc/ls
394	3955-7739	Leland Schaffer	Eldon E. Funk	1967	I	642	F	Osp/ls
395	3956-7740	Harry Peckman	Rev. A. S. McCans	1966	I	670	S	Om/sh
396	3951-7741	Marion Elementary Sch.	---	---	T	622	F	Osp/ls
397	4003-7742	Letterkenny Elementary Sch.	---	---	T	730	F	Osp/ls
398	3955-7739	Charles Garner	Eldon E. Funk	1967	H	626	F	Osp/ls
399	3955-7745	William Dowling	S. H. Palmer	1967	C	621	S	Om/sh
400	3955-7746	Glenn Homseholder	Rev. A. S. McCans	1967	I	588	S	Om/sh
401	3946-7749	Columbia Gas Transmission Co.	Ralph E. Robison	1969	C	518	S	Ops/dm
402	3953-7751	Edna Bivens	---	1952	H	615	S	Orr/ls
403	3950-7749	Barrie Hawk	---	1915	S	590	S	Ops/dm
404	3954-7752	Goldfish Barn	Ralph E. Robison	1977	U	682	S	Osp/ls
405	3949-7754	Mercersburg Bor.	Moody Drilling Co., Inc.	1971	P	560	V	Orr/ls
406	3956-7738	Diller Bros. Farm	Ralph E. Robison	1976	H	658	F	Osp/ls
407	3949-7754	Mercersburg Bor.	Moody Drilling Co., Inc.	1971	P	565	S	Orr/ls
408	3951-7732	Penn National Golf Course	Eldon E. Funk	1976	U	1044	S	Ct/dm
409	3950-7742	Gibbles Potato Chips	Ralph E. Robison	---	N	601	S	Om/sh
410	3958-7734	Leroy Diller	Lester E. Funk	1977	H	760	H	Ce/ls
411	3950-7742	Gibbles Potato Chips	Ralph E. Robison	---	N	603	S	Om/sh
412	3954-7740	Chambersburg Waste Paper Co., Inc.	Eldon E. Funk	1976	N	585	W	Osp/ls
413	3950-7742	Gibbles Potato Chips	---	---	N	603	S	Oc/ls
414	3951-7732	Penn National Golf Course	Eichelberger Well Drilling	1967	I	875	W	Ct/dm
415	3950-7742	Gibbles Potato Chips	---	---	H	604	S	Oc/ls
416	3951-7732	White Rock Water Co.	Eldon E. Funk	1974	P	880	W	Ct/dm
417	3950-7742	Cloverbloom Market	Ralph E. Robison	1970	C	600	S	Oc/ls
418	3956-7739	Pet Inc. Frozen Foods Div.	---	---	A	602	V	Oc/ls
419	3946-7740	Grove Mfg. Co.	Ralph E. Robison	1968	N	823	S	Czl/ls
420	3955-7740	U. S. Paper Mill Inc.	---	1953	H	590	S	Om/sh

(CONTINUED)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity ([gal/min]/ft)/ rate (gal/min)	Hardness (mg/L)	Specific conductance (micromhos at 25°C)	pH	Well number
111	---	6	---	1	3/75	---	---	---	---	---	Fr-340
150	---	---	---	---	---	---	---	---	---	---	341
372	29	6	---	24	3/75	15	0.08/15	---	---	---	342
460	---	6	---	---	---	11	0.04/11	---	---	---	351
113	20	6	40;65;80	40	4/75	15	0.75/15	171	340	---	352
52	---	---	---	7	3/77	---	0.26/5	222	500	---	353
98	---	---	---	19	4/77	---	---	---	---	---	354
95	---	---	---	7	5/77	---	---	---	---	---	355
101	---	---	---	18	5/77	---	---	---	---	---	356
98	---	---	---	17	5/77	---	---	---	---	---	357
97	---	---	---	19	5/77	---	1.1/14	---	265	---	358
90	---	---	---	28	3/77	---	---	---	---	---	359
21	---	---	---	4	3/77	---	---	---	---	---	360
40	---	---	---	21	3/77	---	---	188	320	---	361
60	---	---	---	6	3/77	---	---	205	370	---	362
410	30	6	80;120;240; 280	18	5/76	20	---	---	---	---	363
270	42	6	80;120;198	24	4/77	16	0.90/16	154	520	---	364
69	---	---	---	---	---	---	---	---	---	---	365
32	---	---	---	28	5/77	---	---	---	---	---	366
112	---	---	---	18	4/77	---	---	222	360	---	367
217	---	---	---	20	4/77	11	---	205	350	---	368
85	---	---	---	6	4/77	35	---	---	---	---	369
70	---	---	---	7	4/77	---	---	256	520	---	370
80	20	6	40;60	30	8/73	20	2.0/20	---	---	---	371
90	22	6	---	9	5/77	---	---	---	260	---	372
80	---	---	---	23	5/77	---	---	---	---	---	373
38	---	---	---	6	5/77	---	---	---	---	---	374
129	---	---	---	21	7/77	---	3.0/19	120	315	---	375
---	---	---	---	25	5/77	---	---	---	---	---	376
23	---	---	---	13	5/77	---	---	---	---	---	377
100	---	---	---	15	5/77	---	0.17/6	205	460	---	378
150	---	---	---	19	5/77	---	---	119	280	---	379
33	---	---	---	20	5/77	---	---	---	---	---	380
110	---	---	---	21	5/77	---	---	171	340	---	381
52	---	---	---	47	5/77	---	---	---	---	---	382
147	---	---	---	22	5/77	---	---	---	---	---	383
418	190	6	163;263	37	7/77	13	0.88/13	188	410	---	384
113	47	12	75;83;101	12	5/77	---	2.3/12	136	295	---	385
110	85	6	---	35	1/65	30	---	188	460	---	386
390	---	---	---	31	7/77	---	---	188	425	---	387
90	---	---	---	43	7/77	---	4.8/11	427	1130	---	388
90	56	6	70;85	53	7/77	---	2.7/8	410	1550	---	389
148	139	6	---	75	7/77	15	---	68	155	---	390
100	---	---	---	59	7/77	---	---	273	545	---	391
---	---	---	---	48	7/77	---	0.85/18	---	---	---	392
723	36	6	---	19	9/77	2	0.03/5	307	790	---	393
80	39	6	80	---	---	---	---	205	620	---	394
66	---	---	---	18	9/77	42	0.92/6	103	285	---	395
247	20	6	---	30	8/77	---	0.76/16	---	---	---	396
---	---	---	---	22	9/77	---	0.08/8	137	365	---	397
230	6	6	215	---	---	---	---	154	380	---	398
80	30	6	22	10	4/67	20	0.67/20	256	450	---	399
97	22	6	---	---	---	42	---	274	730	---	400
322	22	6	217	40	9/77	---	---	290	590	---	401
90	---	---	---	51	10/77	---	---	205	520	---	402
110	---	6	---	30	9/77	---	0.09/10	340	750	---	403
350	38	6	140	18	10/77	1	0.03/2	308	750	---	404
280	90	8	92;168;221	17	5/71	273	150/75	---	---	---	405
230	21	6	230	23	5/78	30	3.5/11	308	750	---	406
295	44	8	58;66	28	5/71	412	300/75	---	---	---	407
298	238	6	240;244;263	184	10/78	50	16/3	154	295	7.6	408
200	---	---	---	---	---	---	---	250	550	---	409
370	60	6	210;355	58	5/78	25	0.25/10	120	240	---	410
322	38	6	80;140	---	---	25	---	---	---	---	411
173	20	6	165	28	6/78	25	---	239	530	---	412
---	---	---	---	---	---	---	---	---	---	---	413
357	---	---	335	30	1/67	130	0.90/130	---	---	---	414
---	---	---	---	---	---	---	---	---	---	---	415
410	152	6	184;203;215; 230;369	---	---	100	---	---	---	---	416
50	21	6	32	25	10/77	15	---	---	---	---	417
50	---	---	---	---	---	---	---	---	---	---	418
262	20	6	120;256	79	7/78	75	---	---	---	---	419
100	---	6	23;85	---	---	---	---	---	---	---	420

TABLE 13.

Well location		Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat-Long							
Fr-421	3947-7740	Grove Mfg. Co.	Ralph E. Robison	1974	N	812	S	Czl/ls
422	3953-7749	Brandts Ch.	do.	1971	H	645	H	Om/sh
423	3947-7740	Grove Mfg. Co.	do.	1968	U	821	S	Czl/ls
424	3953-7732	Marlin Hege	York Drilling Co., Inc.	1967	H	885	S	Cwb/ls
425	3946-7740	Grove Mfg. Co.	---	---	U	810	S	Czl/ls
426	3953-7733	Robert Diller	---	---	H	795	V	Ce/ls
427	3948-7743	Anvil Products Inc.	Ralph E. Robison	1973	N	561	H	Osp/ls
428	3953-7735	John Sollenberger	---	---	H	775	S	Ce/ls
429	3948-7743	Anvil Products Inc.	Ralph E. Robison	1973	N	561	H	Osp/ls
430	3955-7740	U. S. Paper Mill Inc.	---	1949	U	575	V	Om/sh
431	3946-7740	D. Hess	David W. Pool	1967	H	799	H	Csg/ls
432	3955-7740	U. S. Paper Mill Inc.	---	1950	U	575	V	Om/sh
433	3946-7740	Lowell Gearhart	Ralph E. Robison	1969	H	765	W	Csg/ls
434	3954-7754	Mt. Parnell Fisheries	do.	1976	Z	595	S	Om/sh
435	3946-7740	Francis Gilbert	David A. Woodward	1968	H	766	H	Ost/ls
436	3954-7753	Mt. Parnell Fisheries	Ralph E. Robison	1976	Z	590	V	Om/sh
437	3946-7740	Harold Martz	Leroy M. and E. S. Wingert	1968	H	760	S	Ost/ls
438	3958-7734	Leroy Diller	---	1956	H	740	S	Ce/ls
439	3948-7744	John Holt	Denis H. Woodward	1975	H	538	V	Osp/ls
440	3957-7733	Monroe Crider	---	1963	H	870	S	Cwb/ls
441	3945-7733	Leroy Martin	John S. Funt	1966	H	722	S	Cwb/ls
442	3958-7732	Robert Baughman	R. L. Whisler	1977	H	860	S	Cwb/ls
443	3946-7732	Glenn Moats	David W. Pool	1968	H	795	S	Cwb/ls
444	4000-7730	N. Zimmerman	R. Galen Martin	1978	H	840	H	Cwb/ls
445	3944-7734	Landis Tool Co.	William H. Lamberson	1966	I	682	S	Ce/ls
446	3958-7732	Annabel Myers	R. L. Whisler	1975	H	908	S	Ct/dm
447	3950-7733	Mont Alto Bor.	Moody Drilling Co., Inc.	1969	P	850	V	Ct/dm
448	4001-7731	Harry Rhones	Eldon E. Funk	1977	H	712	U	Ce/ls
449	3951-7747	Sary Myers	Martin W. Shatzer	1975	H	490	V	Om/sh
450	4001-7734	Lester Martin	Lester E. Funk	1977	S	710	F	Csg/ls
451	3948-7737	Hess Orchards	Ralph E. Robison	1976	U	821	S	Czl/ls
452	4000-7734	Donald Bard	Lester E. Funk	1977	H	685	S	Osh/ls
453	3948-7737	Hess Orchards	Ralph E. Robison	1976	U	840	H	Czl/ls
454	4004-7741	L. Frey	R. Galen Martin	1978	H	770	S	Om/sh
455	3947-7740	Grove Mfg. Co.	Ralph E. Robison	1978	U	816	S	Czl/ls
456	4003-7742	Robert Moore	do.	1975	H	808	S	Om/sh
457	3944-7734	Antietam Humane Soc.	do.	1975	T	650	S	Ce/ls
458	4002-7738	Raymond Pugh	David W. Pool	1966	H	683	S	Om/sh
459	3943-7735	Washington Twp.	Harrisburg's Kohl Bros.	1977	P	579	V	Ce/ls
460	4003-7740	Martin Burkholder	R. Galen Martin	1977	H	690	S	Om/sh
461	3945-7734	Dr. Guiton	Paul E. Dimmig	1966	H	718	H	Ce/ls
462	3955-7733	New Enterprise Lime and Stone	---	---	H	785	S	Cwb/ls
463	3944-7733	Dr. Joseph Miller	Paul E. Dimmig	1966	H	700	H	Ce/ls
464	3954-7751	Charles Dice	Martin W. Shatzer	1974	H	720	S	Om/sh
465	3944-7733	William Minick	Weldo W. Funt	1967	H	700	H	Ce/ls
466	3953-7747	Janet Crider	Ray R. Toms, Jr.	1973	H	600	H	Om/sh
467	3945-7730	William Ernst	Denis H. Woodward	1975	H	780	S	Ct/dm
468	3955-7748	Eugene Shatzer	Martin W. Shatzer	1976	H	680	S	Oc/ls
469	3947-7736	Five Forks Ch.	Ralph E. Robison	1976	H	740	H	Ce/ls
470	3955-7749	Russell Hutton	Eldon E. Funk	1969	H	775	S	Osp/ls
471	3946-7736	C. Manahan	Denis H. Woodward	1978	H	745	S	Czl/ls
472	3957-7734	Albert Wagner	Eldon E. Funk	---	H	740	S	Ce/ls
473	3945-7733	Earl Mover	Denis H. Woodward	1978	H	700	S	Ce/ls
474	4001-7732	Ray Brenize	Eldon E. Funk	1977	H	790	W	Ce/ls
475	3948-7740	Henry Smith	Ralph E. Robison	1976	H	742	S	Czl/ls
476	3952-7746	Arnold Meredith	Paul C. Ramer	1972	H	560	S	Om/sh
477	3949-7739	John Diller	---	---	S	805	U	Csg/ls
478	3953-7747	Glenn Martin	Ralph E. Robison	1976	H	650	H	Om/sh
479	3948-7738	John Diller	---	---	U	842	W	Czl/ls
480	3953-7741	Reuben Horst	Ralph E. Robison	1975	H	570	S	Om/sh
481	3946-7744	L. Berrey	Ray R. Toms, Jr.	1973	H	560	U	Orr/ls
482	3953-7743	Kenneth Hershey	Ralph E. Robison	1972	H	705	H	Om/gwss
483	3943-7736	Bruce Neibert, Jr.	Ray R. Toms, Jr.	1978	H	578	V	Czl/ls
484	3952-7743	Terry Davis	Ralph E. Robison	1970	H	680	H	Om/gwss
485	3943-7737	J. Schmid	Denis H. Woodward	1976	H	675	H	Czl/ls
486	3955-7749	Robert Andrews	Martin W. Shatzer	1973	H	695	S	Osp/ls
487	3943-7737	J. Schmid	Denis H. Woodward	1976	H	665	H	Czl/ls
488	3956-7734	John Den Hartog	Lester E. Funk	1977	I	798	W	Cwb/ls
489	3945-7737	Francis Clopper	Denis H. Woodward	1976	H	690	H	Czl/ls
490	4002-7736	Larry Baker	R. L. Whisler	1977	H	715	S	Om/gwss
491	3946-7736	Larry Angle	Denis H. Woodward	1977	H	725	H	Czl/ls
492	4006-7737	Paul Bert	Eldon E. Funk	1974	I	690	W	Om/sh
493	3944-7743	Pa. Dept. of Transp.	Harrisburg's Kohl Bros.	1970	P	655	U	Orr/ls
494	4006-7737	Paul Bert	Eldon E. Funk	1977	H	725	H	Om/sh
495	3944-7743	Pa. Dept. of Transp.	Harrisburg's Kohl Bros.	1970	U	655	U	Orr/ls
496	4006-7737	Paul Bert	---	1969	I	720	S	Om/sh
497	3947-7733	R. Kline	David A. Woodward	1977	H	640	V	Qc/sd
498	4003-7736	Stephen Reed	R. L. Whisler	1976	H	660	S	Om/gwss
499	3947-7745	Greencastle Products Co.	---	---	N	587	H	Om/sh
500	4000-7736	Oscar Wagner	Eldon E. Funk	1969	H	670	F	Orr/ls
501	3947-7745	Greencastle Products Co.	David A. Woodward	1977	N	582	H	Om/sh
502	4000-7737	Emery Etter	R. Galen Martin	1977	H	677	F	Osp/ls
503	3951-7739	Willis Lesher	Ray R. Toms, Jr.	1970	U	770	S	Osh/ls
504	4001-7737	Frank Gaugler	Ralph E. Robison	1974	H	775	H	Om/sh

(CONTINUED)

Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gal/min)	Specific capacity ([gal/min]/ft)/rate (gal/min)	Hardness (mg/L)	Specific conductance (micromhos at 25°C)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
127	70	6	90	47	7/78	102	9.9/121	308	610	---	Fr-421
50	31	6	45	8	10/77	15	---	---	---	---	422
352	24	6	90	61	7/78	8	---	---	---	---	423
175	110	6	---	91	11/77	---	1.2/7	137	400	---	424
99	---	---	---	82	10/77	---	---	---	---	---	425
60	---	---	---	13	11/77	---	950/9	154	395	---	426
225	23	6	60;120;193	51	10/77	30	0.30/28	308	600	---	427
150	---	---	---	70	11/77	---	14/4	222	500	---	428
300	29	6	140	50	10/77	9	0.09/13	360	670	---	429
160	---	---	---	1	10/77	30	---	---	---	---	430
261	---	---	48	---	---	1	---	---	---	---	431
200	---	---	---	1	10/77	---	0.16/10	34	310	---	432
202	19	6	125;184	---	---	6	---	---	---	---	433
250	22	8	80;160	---	---	50	---	---	---	---	434
75	---	6	---	30	11/77	---	---	305	690	---	435
160	21	8	80;120	---	---	60	---	---	---	---	436
140	35	6	50;80	30	7/68	5	---	---	---	---	437
285	2	6	---	84	5/78	---	0.05/5	120	300	---	438
200	23	---	70;190	20	6/75	12	0.40/12	---	---	---	439
160	---	---	---	55	5/78	---	5.3/8	171	320	---	440
197	20	6	32;123	18	11/77	12	0.34/7	370	770	---	441
198	195	6	197	57	5/78	5	0.06/5	---	---	---	442
85	31	6	72	31	6/68	30	3.0/30	120	320	---	443
147	123	6	---	58	5/78	50	5.0/5	171	395	---	444
155	47	6	60;80;130	30	8/66	100	---	345	---	---	445
125	109	6	125	107	5/78	20	4.7/9	68	150	---	446
325	105	12	115;170;200;223;262;295	55	5/69	134	24/120	---	---	---	447
70	64	6	68	29	5/78	10	7.5/6	137	360	---	448
45	21	6	10;40	9	10/75	30	2.7/30	256	625	---	449
123	40	6	116	36	7/78	40	4.2/4	222	510	---	450
323	21	6	100	5	4/78	---	0.03/1	290	700	---	451
370	20	6	365	35	9/77	25	---	256	540	---	452
397	21	6	80	8	5/78	---	0.04/2	---	---	---	453
196	34	6	---	---	---	9	---	---	---	---	454
111	50	6	106;111	50	5/78	110	25/16	256	580	---	455
97	39	6	50;80;90	---	---	25	---	34	75	---	456
307	35	6	50;95;255	60	5/78	15	0.12/20	239	540	---	457
70	52	6	26	21	10/66	40	8.0/40	86	230	---	458
110	40	6	18;70;98	8	5/78	52	13/50	256	640	---	459
96	21	6	---	19	5/78	22	---	51	320	---	460
300	65	6	85	85	9/66	3	---	---	---	---	461
107	---	---	---	12	5/78	---	6.3/5	120	250	---	462
85	74	6	80	80	9/66	30	---	12	520	---	463
88	21	6	60;84	17	6/78	18	1.8/18	154	380	---	464
103	17	6	92	22	1/67	24	0.45/24	---	---	---	465
120	25	6	60;120	---	---	12	---	103	250	---	466
125	50	6	95;115	45	5/78	30	0.67/30	---	---	---	467
300	30	6	180	---	---	6	---	325	650	---	468
217	27	6	---	71	5/78	8	0.17/8	---	---	---	469
220	70	6	216	---	---	---	---	---	---	---	470
165	20	6	90;140	68	6/78	30	24/7	308	460	---	471
100	75	6	84;95	---	---	20	---	---	---	---	472
200	84	6	105;165	12	6/78	30	4.5/5	222	470	---	473
470	20	6	465	95	7/78	20	---	154	650	---	474
200	---	---	---	---	---	4	---	786	1550	---	475
200	20	6	100;130;190	56	6/78	8	0.10/8	51	235	---	476
277	---	---	---	31	1/65	---	0.05/5	274	660	---	477
127	23	6	60;80	9	6/78	15	---	137	310	---	478
51	---	---	---	46	6/78	---	54/9	222	600	---	479
217	19	6	90;150	---	---	20	---	120	315	---	480
165	27	---	80;160	---	---	6	---	---	---	---	481
104	---	---	80	---	---	10	--	86	---	---	482
307	20	---	---	18	6/78	30	0.52/11	274	810	---	483
110	26	6	70;90	10	11/70	10	---	---	---	---	484
433	17	6	75	30	7/76	1	0.03/1	257	655	---	485
70	51	6	65	15	6/78	20	37/9	171	330	---	486
375	22	6	350	20	8/76	8	0.04/8	393	880	---	487
248	130	8	160;210;240	25	12/77	200	7.1/85	---	---	---	488
250	25	6	175;225	68	6/78	3	0.03/3	342	850	---	489
140	40	6	130	62	6/78	50	0.89/3	102	245	---	490
163	20	6	150;163	55	6/78	---	40/8	239	625	---	491
140	12	6	60;85	10	7/78	80	0.98/80	---	---	---	492
341	40	6	120	20	6/78	1	0.04/2	14	620	---	493
148	20	6	90;124	20	8/77	35	---	---	---	---	494
231	---	---	---	20	6/78	---	0.06/5	273	640	---	495
130	---	---	---	9	7/78	150	7.9/124	120	240	---	496
80	66	6	68	26	10/77	12	0.50/12	---	---	---	497
185	42	6	100;180	4	7/78	5	---	---	---	---	498
265	---	---	---	62	10/78	---	0.90/33	393	875	---	499
70	20	6	65	39	7/78	15	9.3/10	273	690	---	500
157	20	6	131	15	9/77	55	11/55	17	625	---	501
70	42	6	---	29	7/78	40	---	---	---	---	502
53	20	6	---	43	7/78	---	---	---	---	---	503
97	28	6	60;80	12	7/78	10	---	86	295	---	504

TABLE 13.

Well location: Number	Well location: Lat-Long	Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/lithology
Fr-505	3951-7739	Willis Lesher	Ralph E. Robison	1977	S	765	W	Osh/ls
506	4003-7734	Donald Crouse	Eldon E. Funk	1977	H	715	W	Om/sh
507	3952-7738	Melvin Lesher	Lester E. Funk	1976	H	782	W	Csg/ls
508	4001-7734	Raymond Martin	R. Galen Martin	1976	H	670	S	Orr/ls
509	3952-7741	Pa. Dept. of Transp.	Harrisburg's Kohl Bros.	1964	U	645	U	Orr/ls
510	4001-7733	Phyllis Erwin	Eldon E. Funk	1970	H	730	S	Czl/ls
511	3951-7741	Pa. Dept. of Transp.	do.	1971	U	641	W	Orr/ls
512	4003-7735	Merle Vaughn	do.	1975	H	645	S	Om/sh
513	3949-7740	Richard Kendall	Ralph E. Robison	1975	H	700	V	Csg/ls
514	3954-7748	R. Fulton	R. Galen Martin	1978	H	645	H	Oc/ls
515	3944-7741	Benjamin Eby	Denis H. Woodward	1971	H	704	W	Osh/ls
516	4005-7734	Sam Wenger, Jr.	Lester E. Funk	1974	H	642	H	Om/sh
517	3943-7742	Melvin Eby	Ralph E. Robison	1969	H	736	S	Orr/ls
518	4001-7730	Hugh Asper	Martin W. Shatzer	1975	H	755	S	Ce/ls
519	3944-7742	Ivan Musselman	Ralph E. Robison	1969	H	718	F	Orr/ls
520	4000-7733	Paul Karper	Eldon E. Funk	1972	H	850	H	Czl/ls
521	3947-7741	Garry Miller	Ralph E. Robison	1974	H	700	W	Osh/ls
522	3957-7737	Harvies Orchard	---	1936	Z	690	F	Osp/ls
523	3945-7739	Walter Barr	Denis H. Woodward	1974	H	702	U	Czl/ls
524	3957-7736	Harvies Orchard	David W. Pool	1967	H	722	F	Csg/ls
525	3943-7740	Elam Martin	Eldon E. Funk	1974	H	630	S	Osh/ls
526	3959-7735	Richard Hurley	R. L. Whisler	1973	H	722	F	Osh/ls
527	3945-7739	Ronald Burckner	David A. Woodward	1975	H	702	U	Czl/ls
528	4005-7734	Ron Hamrah	Lester E. Funk	1978	H	560	V	Om/sh
529	3945-7745	Duane Dillard	Martin W. Shatzer	1976	H	618	S	Osp/ls
530	4003-7733	Harold Best	Eldon E. Funk	1969	H	728	F	Osp/ls
531	3945-7745	Duane Dillard	Ralph E. Robison	1971	U	518	S	Osp/ls
532	4004-7733	Clyde Fogelsanger	R. Galen Martin	1977	H	645	W	Osp/ls
533	3943-7743	Floyd Gameman	Denis H. Woodward	1975	H	633	S	Orr/ls
534	4002-7733	Wayne Martin	---	1967	H	688	F	Osp/ls
535	3952-7741	Shalom Christian Sch.	R. Galen Martin	1978	T	610	S	Oc/ls
536	4004-7732	James Witter	---	1963	H	618	S	Orr/ls
537	3944-7739	John Mowen	Denis H. Woodward	1975	H	625	S	Csg/ls
538	4004-7733	John Diehl	---	1965	H	640	S	Oc/ls
539	3951-7740	Dennis Horst	Ralph E. Robison	1977	H	695	W	Orr/ls
540	3959-7731	William Wadel	Eldon E. Funk	1969	H	825	S	Cwb/ls
541	3952-7739	Robert Helman	Lester E. Funk	1976	S	760	S	Ost/ls
542	3953-7736	Paul Martin	Ralph E. Robison	1978	H	759	S	Czl/ls
543	3951-7741	Charles Hunsecker	do.	1976	H	641	U	Orr/ls
544	3956-7736	Harvey Lehman	---	1959	S	642	F	Czl/ls
545	3949-7741	Tom Bryson	Ralph E. Robison	1977	H	700	W	Csg/ls
546	3954-7734	Carl Helman	---	---	S	760	S	Ce/ls
547	3949-7740	Sam Christophel	Ralph E. Robison	1978	H	770	U	Czl/ls
548	3956-7738	George Black	do.	1972	H	635	F	Osp/ls
549	3950-7736	Clarence Wildeson	do.	1971	H	785	V	Ce/ls
550	3958-7738	Raymond Shoemaker	do.	1966	H	698	F	Oc/ls
551	3948-7733	Lester Bakner	Denis H. Woodward	1970	H	810	S	Ct/dm
552	3954-7739	Lynn Martin	Ray R. Toms, Jr.	1978	S	650	S	Ops/dm
553	3947-7734	John Woll	David A. Woodward	1978	H	740	S	Cwb/ls
554	3953-7739	Glenn Martin	Eldon E. Funk	1969	H	670	S	Orr/ls
555	3950-7735	Dennis Guessford	David A. Woodward	1978	H	858	S	Ce/ls
556	4005-7733	William Bassin	K. R. Whisler	1971	H	582	S	Oc/ls
557	3947-7733	David Woodward	Denis H. Woodward	1970	H	750	S	Ct/dm
558	4001-7735	Raymond Martin	Eldon E. Funk	1969	H	625	S	Osp/ls
559	3951-7737	Rodger Hess	Ralph E. Robison	1975	H	815	S	Ce/ls
560	4005-7738	John Holtry	R. L. Whisler	1969	H	750	S	Om/sh
561	3950-7739	P. Donough	Paul L. Fahnestock	1977	H	821	H	Czl/ls
562	4001-7736	Sharpe Keller	Ralph E. Robison	1966	H	632	S	Ops/dm
563	3946-7730	Kenneth Toms	do.	1974	H	805	S	Cwb/ls
564	3953-7739	Amos Eby	do.	1967	H	670	F	Orr/ls
565	3946-7732	Robert Kipe	Denis H. Woodward	1975	H	780	W	Cwb/ls
566	3955-7737	George Mikkelson	Ralph E. Robison	1975	H	685	H	Orr/ls
567	3946-7732	Lonnie Carbaugh	William H. Lamberson	1968	H	740	S	Cwb/ls
568	4004-7736	Larry Wenger	R. L. Whisler	1977	H	635	W	Om/sh
569	3947-7732	Kenneth Dickinson	Denis H. Woodward	1967	U	800	W	Ct/dm
570	4007-7735	Mark Beam	Ralph E. Robison	1975	H	605	S	Om/sh
571	3952-7741	Shalom Christian Academy	do.	1975	T	620	S	Oc/ls
572	3953-7755	Worrell	do.	1977	H	700	S	Orr/ls
573	3947-7735	John Aldridge	Denis H. Woodward	1971	H	690	S	Ce/ls
574	3959-7737	Jack Huston	Eldon E. Funk	1966	H	670	F	Osp/ls
575	3949-7735	Pat Pryor	Ralph E. Robison	1975	H	775	S	Ce/ls
576	4001-7735	John Mummau	Eldon E. Funk	1966	H	650	S	Orr/ls
577	3949-7735	John Rudolph	Ray R. Toms, Jr.	1974	S	795	W	Ce/ls
578	4000-7732	J. Wadel	Larry G. Walters	1978	H	770	H	Ce/ls
579	3949-7734	Jay Baker	S. H. Palmer	1967	H	810	S	Ce/ls
580	4005-7736	Samuel Swanger	R. L. Whisler	1976	H	600	S	Om/sh
581	3948-7736	Mike Friel	Paul C. Ramer	1974	H	805	S	Ce/ls
582	4005-7736	Leroy Bert	R. L. Whisler	1976	S	672	H	Om/sh
583	3948-7735	Abram Hess	Denis H. Woodward	1970	H	798	H	Ce/ls
584	4006-7736	Williams Ile	Lester E. Funk	1976	H	678	S	Om/sh
585	3949-7735	Dennis Gift	Ray R. Toms, Jr.	1972	H	810	S	Cwb/ls
586	4007-7735	Charles Holtry	K. R. Whisler	1969	H	600	S	Om/sh
587	3949-7735	Harry Atherton	Ralph E. Robison	1975	H	810	W	Ce/ls
588	4008-7736	Carl Ashway	Eldon E. Funk	1970	H	640	S	Om/sh
589	3949-7743	Ray Williams	Ralph E. Robison	1977	H	568	S	Osp/ls
590	4007-7736	Trinity Assoc. of God	R. L. Whisler	1975	T	635	S	Om/sh

(CONTINUED)

Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gal/min)	Specific capacity ([gal/min]/ft)/rate (gal/min)	Hard-ness (mg/L)	Specific conduc-tance (micro-mhos at 25°C)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
100	42	6	90	26	7/78	30	35/45	274	625	---	Fr-505
60	30	6	45;56	14	11/77	20	---	---	---	---	506
485	100	6	475	60	1/76	25	---	---	---	---	507
92	26	6	45;83	---	---	10	---	376	950	---	508
240	27	6	120;180;245	22	9/77	7	0.03/7	---	---	---	509
115	20	6	112	---	---	15	---	222	560	---	510
105	43	6	62;67	19	10/77	33	0.50/33	---	---	---	511
98	24	6	65;90	35	4/75	5	---	308	840	---	512
82	28	---	70	10	8/78	30	---	274	580	---	513
356	21	6	---	110	7/78	5	0.08/9	308	620	---	514
112	---	---	112	30	8/78	80	4.0/80	308	710	---	515
75	40	6	60;72	---	---	20	---	86	220	---	516
142	21	6	117	47	8/78	3	---	342	790	---	517
80	40	6	68;75	49	7/78	15	32/5	171	380	---	518
59	57	6	58	29	8/78	25	19/8	257	560	---	519
260	20	6	245	100	8/78	15	0.25/6	239	630	---	520
127	31	6	100	38	8/78	10	6.6/8	274	590	---	521
80	---	---	---	63	8/78	---	9.1/7	205	520	---	522
100	40	---	75;86	32	3/74	20	1.1/20	---	---	---	523
230	72	6	65;218	54	8/78	30	12/10	137	330	---	524
152	27	6	45;112	27	8/78	20	0.20/11	257	620	---	525
67	24	6	65	56	8/78	20	20/4	205	560	---	526
175	7	6	90;170	60	4/75	10	---	---	---	---	527
98	---	---	95	8	8/78	5	---	103	300	---	528
305	50	6	125;305	50	9/78	60	3.0/60	256	570	---	529
260	51	6	245	---	---	5	---	222	580	---	530
172	22	6	60;160	30	5/71	5	---	---	---	---	531
350	20	6	95;342	67	8/78	50	0.28/11	308	700	---	532
425	15	6	200;225	15	4/75	3	0.03/3	274	600	---	533
220	---	---	---	48	8/78	---	7.6/8	291	710	---	534
300	21	6	125;200;218;250	---	---	35	---	---	---	---	535
190	---	---	---	31	8/78	---	0.39/6	376	1700	---	536
65	20	6	25;50;65	25	9/78	20	1.3/20	274	595	---	537
108	50	6	---	35	8/78	---	2.0/4	293	600	---	538
292	71	6	65;280	21	9/78	15	0.36/9	274	605	---	539
200	123	6	195	57	8/78	5	0.61/6	103	250	---	540
573	39	6	565	24	10/76	15	---	291	595	---	541
232	82	6	220	74	8/78	30	2.6/9	393	1050	---	542
80	41	6	35;75	22	9/78	30	---	325	690	---	543
130	---	---	---	83	8/78	---	0.44/7	256	805	---	544
115	27	6	110	35	9/78	30	---	342	750	---	545
126	---	---	---	34	8/78	---	0.15/4	274	700	---	546
142	64	6	90;130	---	---	10	---	308	620	---	547
322	21	6	80	26	8/78	7	0.04/8	256	760	---	548
65	22	6	50	10	7/71	20	17/100	308	670	---	549
200	---	---	---	52	9/78	---	0.22/3	325	860	---	550
197	89	6	140;185	90	6/70	14	0.35/14	---	---	---	551
245	24	6	---	30	9/78	---	0.08/11	---	680	---	552
97	30	6	26;82	---	---	8	0.18/8	---	---	---	553
335	20	6	270	31	9/78	---	0.04/5	359	780	---	554
322	21	6	127;210	100	5/78	5	0.08/5	---	---	---	555
194	20	6	140;190	27	7/71	5	---	274	540	---	556
89	20	6	70;78	30	6/70	15	0.50/15	290	680	---	557
115	78	6	90;110	45	9/78	25	3.9/10	256	560	---	558
172	86	6	130	55	9/78	5	---	239	495	---	559
72	40	6	65	20	9/69	12	0.38/12	51	160	---	560
260	19	6	250	60	9/78	22	0.13/22	274	600	---	561
145	10	6	---	23	9/78	---	---	342	700	---	562
202	83	6	180	---	---	6	---	103	215	---	563
157	30	6	60;150	30	12/67	8	---	256	650	---	564
140	13	6	125;140	89	9/78	15	0.38/15	274	560	---	565
157	41	6	120	56	9/78	10	0.91/7	393	2000	---	566
105	26	6	95	40	10/68	8	---	---	---	---	567
65	44	6	50;60	30	11/78	50	---	86	220	---	568
90	40	6	82;87	56	9/67	16	1.8/16	---	---	---	569
82	25	6	45;65	23	9/78	20	---	120	320	---	570
247	24	6	80	---	---	3	---	---	---	---	571
205	---	---	---	70	9/78	2	0.04/5	188	400	---	572
200	6	6	175	45	9/78	6	0.06/6	342	670	---	573
230	8	6	225	---	---	---	---	239	560	---	574
112	23	6	40;80;100	---	---	15	---	376	750	---	575
140	14	6	125	37	10/78	---	---	291	640	---	576
135	30	6	60;80;130	13	9/78	---	4.0/20	---	---	---	577
145	127	6	---	40	6/78	40	---	---	---	---	578
74	---	---	40;70	37	9/78	10	0.33/10	274	560	---	579
290	82	6	90;150	33	10/78	3	---	120	305	---	580
215	40	5	103;195	101	9/78	5	0.03/5	256	570	---	581
80	42	6	60;78	28	11/78	80	---	222	305	---	582
130	50	6	125	62	9/78	5	0.25/5	393	850	---	583
98	22	6	65;90	18	10/76	20	---	---	---	---	584
105	50	5	---	---	---	12	---	---	---	---	585
102	29	6	70	15	10/78	12	---	103	305	---	586
157	54	6	120;150	---	---	15	---	---	---	---	587
42	22	6	39	---	---	---	---	---	---	---	588
217	44	---	190	30	9/77	3	---	---	---	---	589
67	21	6	55;60	---	---	35	---	---	---	---	590

TABLE 13.

Well location		Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat-Long							
Fr-591	3948-7737	Hess Orchards	Ralph E. Robison	1975	H	751	W	Ce/ls
592	4008-7737	Ellis Piper	R. L. Whisler	1975	H	755	S	Om/sh
593	3948-7737	Carrell Baer	R. Galen Martin	1978	S	725	S	Ce/ls
594	4009-7736	W. Cornelius	R. L. Whisler	1971	H	745	S	Om/sh
595	3951-7751	Charles Raker	Martin W. Shatzer	1977	S	555	U	Osp/ls
596	4006-7738	Marshall Brantner	Eldon E. Funk	1969	H	710	S	Om/sh
597	3947-7750	Barry Newcomer	Denis H. Woodward	1976	H	548	H	Orr/ls
598	4007-7736	Barry Porter	Eldon E. Funk	1973	H	680	H	Om/sh
599	3947-7750	Merwyn Cunningham	Ralph E. Robison	1974	H	548	H	Orr/ls
600	4003-7740	George Jones	K. R. Whisler	1967	H	702	S	Om/sh
601	3948-7750	Donald Weaver	Ralph E. Robison	1968	H	550	H	Orr/ls
602	4001-7738	Edward Garman	do.	1971	H	670	S	Om/sh
603	3948-7749	Marvin Hissong	---	---	S	558	H	Osp/ls
604	4004-7737	R. Bender	R. Galen Martin	1978	S	670	W	Om/sh
605	3947-7749	Glen Landman	Ray R. Toms, Jr.	1973	H	560	H	Ops/dm
606	4005-7738	Allen Wenger	Eldon E. Funk	1976	H	670	S	Om/sh
607	3945-7746	Aden Buchanan	S. H. Palmer	1974	H	562	S	Om/sh
608	4003-7739	Jerry Foust	Eldon E. Funk	1977	H	690	S	Om/sh
609	3945-7746	Darman Steele	Ralph E. Robison	1975	H	565	H	Om/sh
610	3953-7738	William Coleman	do.	1969	H	695	V	Osh/ls
611	3945-7746	Richard Chilcote	S. H. Palmer	1970	U	603	H	Om/gwss
612	3953-7740	Robert Dehart	Ralph E. Robison	1977	H	625	H	Oc/ls
613	3945-7746	Rodger Bowman	S. H. Palmer	1975	H	545	S	Om/sh
614	4003-7737	Jay Blair	Eldon E. Funk	1966	H	702	H	Om/sh
615	3946-7742	Jacob Bemsiderfer	Paul C. Ramer	1973	H	680	S	Orr/ls
616	4005-7736	Paul Musser	Eldon E. Funk	1966	H	675	H	Om/sh
617	3945-7739	Carroll Tracey	Denis H. Woodward	1976	S	662	W	Czl/ls
618	4005-7739	John Mohler	Eldon E. Funk	1973	H	680	S	Om/sh
619	3948-7747	Robert Grove	Martin W. Shatzer	1968	U	580	H	Om/sh
620	4004-7739	Harry Hasting	Ralph E. Robison	1972	H	650	S	Om/sh
621	3947-7748	Donald Donahue	do.	1974	H	595	S	Om/sh
622	4007-7738	Ray Swartz	K. R. Whisler	1976	H	742	S	Om/sh
623	3946-7750	Bruce Jones	Ralph E. Robison	1971	H	465	S	Osp/ls
624	4004-7740	Wayne Gayman	Martin W. Shatzer	1966	H	725	S	Om/sh
625	3945-7751	William McNulty	Ralph E. Robison	1967	H	530	F	Orr/ls
626	4005-7733	Jay Chamberlin	Eldon E. Funk	1973	H	570	W	Om/sh
627	3948-7750	Paul Helman	Ralph E. Robison	1972	H	505	F	Osh/ls
628	3953-7748	Miller and Kerlin Constr.	Martin W. Shatzer	1978	H	625	H	Om/sh
629	3947-7752	Stanley Sites	Ralph E. Robison	1971	H	505	H	Ops/dm
630	3955-7753	Gary Black	Martin W. Shatzer	1975	H	762	S	Om/sh
631	3945-7751	David McCandless	Ralph E. Robison	1971	---	525	S	Orr/ls
632	3949-7756	Warren Greco	Martin W. Shatzer	1975	H	690	S	Orr/ls
633	3949-7750	J. Stoner	Ralph E. Robison	1969	H	542	S	Osh/ls
634	3951-7752	Elwood Heckman	R. S. and D. H. Shellhammer	1975	S	570	F	Oc/ls
635	3949-7750	J. Stoner	Ralph E. Robison	1967	U	565	H	Osh/ls
636	3952-7746	B. Henry	Martin W. Shatzer	1978	H	562	S	Om/sh
637	3949-7751	John Stouffer	Ralph E. Robison	1967	H	545	F	Orr/ls
638	3951-7748	Harry Myers	do.	1970	H	535	S	Om/sh
639	3951-7747	George Miller	Paul C. Ramer	1972	H	520	S	Osp/ls
640	3950-7753	Merle Miller	Ralph E. Robison	1976	H	570	S	Om/sh
641	3951-7747	L. Horsh	Martin W. Shatzer	1978	H	500	S	Osp/ls
642	3950-7753	James Mills	S. H. Palmer	1974	H	570	S	Om/sh
643	3951-7748	Robert Barnes	Ralph E. Robison	1974	H	540	S	Oc/ls
644	3948-7753	Roy Keller	do.	1967	H	620	S	Ops/dm
645	3948-7748	Richard Myers	do.	1969	H	620	H	Om/sh
646	3950-7756	Gerald Monninger	do.	1975	H	710	S	Orr/ls
647	3948-7748	L. Coble	do.	1967	H	620	H	Om/sh
648	3952-7756	Donald Riley	Ray R. Toms, Jr.	1975	H	780	V	Osp/ls
649	3949-7733	Nelson Lehman	Martin W. Shatzer	1976	H	852	S	Ct/sh
650	3953-7754	Bud Dyler	do.	1975	H	685	H	Om/sh
651	3949-7733	Thomas Null	Denis H. Woodward	1970	H	862	S	Ct/ss
652	3952-7752	Paul Zeger	Martin W. Shatzer	1977	H	620	S	Om/sh
653	3949-7734	James Carl	Ralph E. Robison	1971	H	795	S	Ct/dm
654	3954-7745	Dale Reamer	do.	1971	H	620	S	Om/sh
655	3947-7732	Ronald Wible	Denis H. Woodward	1969	H	815	S	Ct/dm
656	3955-7744	A. Martin	Martin W. Shatzer	1978	H	590	S	Om/sh
657	3947-7732	Norbert Wible	Denis H. Woodward	1971	H	820	S	Ct/dm
658	3955-7737	Jack Saunders	Ralph E. Robison	1977	H	665	S	Osh/ls
659	3946-7732	Earl Moatz	Denis H. Woodward	1969	H	795	S	Ct/dm
660	4006-7737	Jack Hockenberry	K. R. Whisler	1974	H	725	H	Om/sh
661	3947-7732	Bernard Frank	Denis H. Woodward	1969	H	800	S	Ct/dm
662	4003-7733	J. Franquet	Eldon E. Funk	1970	H	658	F	Osp/ls
663	3947-7751	Heisey Orchard	Ralph E. Robison	1969	H	520	S	Orr/ls
664	3957-7737	T. Bundy	Lester E. Funk	1977	H	698	U	Orr/ls
665	3947-7751	Heisey Orchard	Ralph E. Robison	1969	H	521	S	Osh/ls
666	4001-7733	W. Brechbiel	Eldon E. Funk	1978	H	725	H	Czl/ls
667	3947-7737	Roy Hade	David A. Woodward	1977	H	755	S	Ce/ls
668	4002-7738	Raymond Pugh	K. R. Whisler	1974	H	660	S	Om/sh
669	3946-7737	Mervin Horst	Ralph E. Robison	1967	S	765	H	Ce/ls
670	3953-7737	Miller's Orchard	Eldon E. Funk	---	H	775	S	Czl/ls
671	3943-7732	Abram Lecron	Denis H. Woodward	1975	S	693	S	Ct/dm
672	4000-7732	Lawrence Mooney	Eldon E. Funk	1972	H	792	S	Ce/ls
673	3944-7736	L. Kipe	David A. Woodward	1978	H	630	S	Czl/ls
674	3956-7735	Gerald Eberly	R. Galen Martin	1977	S	722	S	Ce/ls
675	3944-7737	Clayton Ford	David A. Woodward	1978	H	640	W	Czl/ls

(CONTINUED)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level Depth below land surface (feet)	Static water level Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity ([gal/min]/ft)/ rate (gal/min)	Hard-ness (mg/L)	Specific conduc-tance (micro-mhos at 25°C)	pH	Well number
97	42	6	84;90;95	35	9/78	30	---	274	600	---	Fr-591
112	48	6	80;110	44	10/78	30	---	86	235	---	592
96	12	6	18	7	9/78	50	130/21	239	560	---	593
56	20	6	45;50	8	12/71	15	0.50/15	103	320	---	594
100	33	6	80;95	36	10/78	20	0.67/20	325	715	---	595
142	20	6	120	---	---	5	---	120	405	---	596
225	25	6	85;105	30	11/76	50	0.25/50	---	---	---	597
165	40	6	150	30	4/73	4	0.04/4	---	---	---	598
202	34	6	170	34	10/78	3	---	---	---	---	599
77	20	6	75	13	10/78	30	5.0/30	103	330	---	600
225	23	6	80	35	9/68	2	---	---	---	---	601
97	30	6	50;80	15	6/71	10	---	---	---	---	602
117	---	---	---	26	10/78	---	---	239	620	---	603
71	33	6	---	22	10/78	50	---	---	---	---	604
210	21	5	80;135;200	33	10/78	3	---	---	---	---	605
148	40	6	140	8	10/78	6	---	136	490	---	606
60	15	---	40;60	15	10/74	10	0.29/10	222	495	---	607
73	24	6	55;68	18	9/77	40	---	---	---	---	608
112	30	---	70;90	---	---	15	---	---	---	---	609
97	38	6	45;80	29	10/78	10	6.0/5	256	770	---	610
85	40	6	30;50;80	19	10/78	20	0.67/20	---	---	---	611
277	23	6	170	---	---	2	---	---	---	---	612
100	20	6	50;100	---	10/75	30	0.60/30	---	---	---	613
110	38	6	65;85;100	---	---	---	---	---	---	---	614
120	12	---	40;110	50	9/73	6	---	---	---	---	615
120	20	6	80;115	55	10/78	---	---	171	540	---	616
125	31	---	95;115	40	10/78	25	0.81/25	---	---	---	617
150	60	6	135	18	1/73	3	---	---	---	---	618
106	44	6	70;90;100	32	10/78	28	2.8/28	---	---	---	619
97	21	6	60;85	---	---	10	---	---	---	---	620
97	22	6	60;90	---	---	10	---	---	---	---	621
125	42	6	---	27	10/78	20	---	---	---	---	622
142	21	6	80;125	32	10/78	8	---	308	660	---	623
89	20	6	---	10	10/78	---	---	120	400	---	624
215	42	6	190	---	---	1	0.03/1	342	1090	---	625
96	40	6	60;95	6	11/78	20	0.62/20	137	420	---	626
80	68	6	70	54	10/78	15	1.00/5	325	850	---	627
120	42	6	110	25	11/78	18	0.60/18	120	305	---	628
82	27	6	---	20	6/71	10	---	290	750	---	629
140	63	6	95;135	39	11/78	12	3.0/12	---	---	---	630
172	20	6	80	20	6/71	2	---	---	---	---	631
85	42	6	80	38	4/75	12	0.60/12	86	280	---	632
127	---	---	80	40	9/69	12	---	---	---	---	633
85	27	6	80	36	11/78	35	1.2/35	239	800	---	634
210	---	---	---	90	10/78	---	---	---	---	---	635
85	31	6	80	20	3/78	15	0.75/15	86	320	---	636
67	54	6	60	49	10/67	25	2.8/7	290	725	---	637
67	30	6	40;60	17	11/78	20	---	171	570	---	638
65	6	5	30;55	30	6/72	20	---	---	---	---	639
172	21	6	80;160	37	11/78	10	---	154	460	---	640
65	42	6	50;60	24	10/78	30	3.0/30	256	620	---	641
85	21	6	54;80	40	7/74	10	0.40/10	---	---	---	642
157	50	6	130	---	---	7	---	---	---	---	643
200	15	6	35;187	22	11/78	5	---	291	1000	---	644
115	26	5	50;110	20	6/69	15	---	290	700	---	645
142	55	6	120	39	11/78	10	---	137	400	---	646
97	22	6	40;82	20	6/67	20	---	---	---	---	647
110	24	6	110	30	9/75	12	---	---	---	---	648
121	104	6	110	60	7/76	15	---	---	---	---	649
135	21	6	95;130	18	11/78	13	0.43/13	171	480	---	650
214	200	6	210	150	7/70	30	0.60/30	124	320	---	651
145	42	6	85;140	40	5/77	10	0.25/10	120	320	---	652
130	93	6	110	60	7/71	10	---	---	---	---	653
142	37	6	80;115	---	---	7	---	---	---	---	654
124	100	6	114	87	6/69	12	---	137	330	---	655
85	41	6	45;80	20	6/78	18	0.45/18	---	---	---	656
107	85	6	95	40	5/71	10	0.40/10	154	340	---	657
202	42	6	120;160	---	---	8	---	---	---	---	658
130	38	6	70;122	65	8/69	10	0.50/10	---	---	---	659
94	29	6	45;85;89	---	---	30	---	---	---	---	660
116	75	6	114	74	8/69	5	0.19/5	156	350	---	661
97	35	6	80	---	---	---	---	---	---	---	662
307	45	6	60;170	58	11/78	10	0.15/11	239	570	---	663
250	157	6	210;245	24	3/77	15	---	---	---	---	664
84	72	6	73	54	11/78	25	---	---	---	---	665
140	70	6	135	52	7/78	12	---	---	---	---	666
97	40	6	79	77	11/78	15	6.0/9	171	360	---	667
67	41	6	50;60	---	---	20	---	---	---	---	668
208	---	---	90	88	11/78	50	---	325	750	---	669
298	65	6	245;270	---	---	3	---	291	760	---	670
400	---	---	100	15	5/75	1	0.04/1	171	370	---	671
200	67	6	165	109	12/78	5	---	---	---	---	672
80	30	6	66	23	3/78	12	0.70/12	---	---	---	673
60	52	6	---	---	---	15	---	---	---	---	674
97	---	---	82	29	11/78	30	15/30	291	625	---	675

TABLE 13.

Well location Number	Lat-Long	Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/lithology
Fr-676	3946-7744	Thomas Younker	Paul L. Fahnestock	1978	H	550	F	Osp/ls
677	3944-7737	Clayton Ford	David A. Woodward	1978	H	625	W	Czl/ls
678	3947-7750	Harry Buchanan	Paul L. Fahnestock	1978	H	545	H	Ops/dm
679	3944-7745	Nevin Martin	R. Galen Martin	1978	H	522	F	Orr/ls
680	3947-7748	O. May	Paul L. Fahnestock	1978	H	605	H	Om/sh
681	3944-7746	do.	S. H. Palmer	1969	H	582	H	Om/sh
682	3945-7757	Paul Musselman	---	1974	H	720	S	Om/sh
683	3944-7746	B. Hassler	S. H. Palmer	1975	H	540	H	Om/sh
684	3953-7750	Melvin Pugh	Ralph E. Robison	1979	H	638	S	Ops/dm
685	3943-7745	Amos Diller	do.	1969	H	570	V	Orr/ls
686	3952-7753	J. Heinbaugh	do.	1978	H	610	S	Om/sh
687	3943-7744	Nevin Grove	Ray R. Toms, Jr.	1973	H	605	S	Orr/ls
688	3949-7750	C. Keller	Ralph E. Robison	1978	H	558	F	Orr/ls
689	3944-7747	Richard Brumbaugh	Martin A. Landis	1966	H	440	S	Om/sh
690	3950-7756	E. Starliper	Ralph E. Robison	1979	H	725	S	Orr/ls
691	3945-7753	J. McClaughlin	Martin W. Shatzer	1978	H	545	S	Om/sh
692	3948-7746	Rev. Donald Bohn	Ralph E. Robison	1978	H	510	S	Om/sh
693	3945-7753	Amos Angle	S. H. Palmer	1967	H	562	S	Om/sh
694	3949-7746	J. Smith	Ralph E. Robison	1978	H	570	S	Om/gwss
695	3944-7755	John Leasure	S. H. Palmer	1969	H	745	V	Osp/ls
696	3950-7745	G. Yeager	Ralph E. Robison	1978	H	610	S	Om/sh
697	3944-7755	Ernest Rohrer	S. H. Palmer	1966	H	930	S	Om/sh
698	3948-7751	H. Stouffer	Ralph E. Robison	1979	H	520	F	Osh/ls
699	3944-7755	Jesse Hornbaker	S. H. Palmer	1969	H	830	S	Om/sh
700	3948-7757	Arthur Overcash	Ralph E. Robison	1979	H	695	S	Om/sh
701	3944-7756	Ray Hornbaker	S. H. Palmer	1966	U	1020	S	Om/sh
702	3947-7752	Patwil Inc.	Ralph E. Robison	1979	H	560	S	Om/sh
703	3944-7753	Charles Timmons	S. H. Palmer	1966	H	637	H	Ce/ls
704	3947-7752	Brett Penrod	Ralph E. Robison	1978	H	570	S	Om/sh
705	3945-7753	Arnold Martin	do.	1971	H	605	S	Om/sh
706	3945-7757	J. Bradley	do.	1979	H	685	S	Om/sh
707	3946-7755	Wayne Heinbaugh	do.	1975	H	540	S	Orr/ls
708	3945-7752	A. Sherwood	R. Galen Martin	1978	H	550	S	Osh/ls
709	3945-7753	Dean Heinbaugh	S. H. Palmer	1969	H	565	H	Om/sh
710	3947-7751	L. Knarr	Ralph E. Robison	1978	H	525	H	Orr/ls
711	3945-7758	Mapel Grove Ch.	S. H. Palmer	1966	H	652	S	Om/sh
712	3952-7747	Susan Foust	Ralph E. Robison	1978	H	560	S	Om/sh
713	3947-7754	Edgar Woodking	S. H. Palmer	1969	H	565	S	Om/sh
714	3955-7737	Grace Brethren Ch.	Ralph E. Robison	1978	H	710	S	Orr/ls
715	3947-7756	John Shives	do.	1976	H	630	F	Om/sh
716	3952-7741	Barnhart	do.	1978	H	580	S	Ops/dm
717	3948-7754	John Leasure	S. H. Palmer	1940	S	580	V	Orr/ls
718	3954-7741	Ronald Wilson	Ralph E. Robison	1978	H	550	S	Om/gwss
719	3948-7755	Howard Witter	Ray R. Toms, Jr.	1974	H	558	V	Orr/ls
720	3951-7739	W. Gossert	Ralph E. Robison	1978	H	750	S	Orr/ls
721	3947-7756	Tom Steiger	---	---	H	550	V	Osp/ls
722	3951-7743	K. Kauffman	Ralph E. Robison	1979	H	560	S	Osp/ls
723	3947-7745	Greencastle Products Co.	Denis H. Woodward	1974	N	583	S	Om/sh
724	3951-7742	Rhoda Slothour	Ralph E. Robison	1978	S	610	H	Oc/ls
725	3944-7740	O. Wehner	do.	1979	H	685	S	Czl/ls
726	4000-7735	R. Monn, Jr.	do.	1978	H	692	S	Orr/ls
727	3957-7743	J. Saunders	do.	1979	H	612	S	Om/sh
728	3949-7740	Mike Layton	do.	1978	H	705	W	Czl/ls
729	3949-7745	E. Bailey	David A. Woodward	1979	H	540	S	Om/sh
730	3946-7750	J. Long	do.	1979	H	505	S	Orr/ls
731	3943-7744	Time O.C., Inc.	Denis H. Woodward	1979	C	630	F	Orr/ls
732	3950-7751	Horst Burkey Farms	Ralph E. Robison	1976	H	545	F	Orr/ls
733	3948-7745	Greencastle Sportsman's Assoc.	do.	1975	U	530	S	Om/sh
734	3950-7746	Boyd Murry	William H. Lamberson	1969	H	610	H	Om/gwss
735	3952-7744	Fred Martin	Ralph E. Robison	1968	H	662	H	Om/gwss
736	3952-7744	Enos Horst	do.	1971	H	645	H	Om/gwss
737	3944-7752	Patrick Grove	do.	1978	H	595	S	Osh/ls
738	3948-7737	S. Swope	David A. Woodward	1978	H	775	S	Ce/ls
739	3947-7733	Bradley Flood	do.	1978	H	755	W	Ct/dm
740	3947-7733	O. Wilhide	do.	1978	H	765	H	Ct/dm
741	3950-7735	O. Starr	do.	1979	H	860	H	Cwb/ls
742	3951-7750	Daniel Meyers	George E. Small	1954	H	562	F	Ops/dm
743	3950-7734	Rick Blubaugh	David A. Woodward	1978	H	955	S	Ct/dm
744	3946-7740	R. Gearhart	do.	1979	H	798	S	Csg/ls
745	3945-7748	Dwight Cottrell	Ralph E. Robison	1977	H	560	S	Om/sh
746	3943-7749	Earl Keefer	S. H. Palmer	1968	H	565	H	Om/sh
747	3952-7738	Glen Wolfe	R. Galen Martin	1978	H	820	S	Czl/ls
748	3946-7742	C. Ehrhart	Ralph E. Robison	1978	H	676	S	Orr/ls
749	3945-7742	George Johnson	do.	1978	H	718	S	Orr/ls
750	3946-7747	W. Massey	do.	1978	H	555	H	Om/sh
751	3951-7745	Richard Durham	do.	1978	H	515	V	Om/sh
752	3954-7738	Bethel Assembly of God	do.	1978	T	745	F	Csg/ls
753	3954-7738	do.	do.	1978	T	745	F	Csg/ls
754	3944-7748	Lee Martin	Denis H. Woodward	1979	H	542	H	Om/sh
755	3957-7754	Raymond Wingert	Martin W. Shatzer	1976	H	755	S	Om/sh
756	3959-7754	Richard Gorman	do.	1976	H	780	S	Osp/ls
757	4000-7753	John Robinson	Lester E. Funk	1977	H	745	S	Osp/ls
758	4001-7752	M. Whitmer	Martin W. Shatzer	1978	H	720	S	Osp/ls
759	4009-7747	E. Coons	Lester E. Funk	1978	H	925	S	Osp/ls
760	4003-7749	Lilly Woy	do.	1977	H	815	S	Osp/ls

(CONTINUED)

Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gal/min)	Specific capacity ([gal/min]/ft)/ rate (gal/min)	Hardness (mg/L)	Specific conductance (micromhos at 25°C)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
155	20	6	100	---	---	15	---	---	---	---	Fr-676
82	38	6	60	20	3/78	25	6.3/25	256	530	---	677
85	21	6	70	---	---	10	---	---	---	---	678
75	29	6	65	32	11/78	50	---	325	700	---	679
120	21	6	80	13	5/79	40	---	308	820	---	680
90	20	6	40;80	35	8/69	10	0.40/10	47	120	---	681
60	21	6	40;60	20	8/74	20	1.00/20	---	---	---	682
78	---	6	40;60;78	30	11/75	20	2.0/20	68	200	---	683
82	20	6	70	21	5/79	20	2.7/18	222	465	---	684
50	28	6	35;47	24	11/78	25	65/13	222	600	---	685
157	21	6	120	---	---	10	---	120	335	---	686
210	24	6	60;140;200	19	11/78	10	---	---	625	---	687
292	50	6	230	---	---	3	---	---	---	---	688
95	22	6	40;85	30	7/66	7	---	---	---	---	689
142	56	6	120	---	---	10	---	---	---	---	690
115	42	6	68;110	---	---	30	0.65/7	153	390	---	691
82	30	6	60;70	---	---	20	---	---	---	---	692
75	46	6	50;70	40	7/67	10	0.50/10	---	---	---	693
127	30	6	60;100	---	---	20	---	---	---	---	694
166	20	6	90;100	10	8/69	1	0.03/1	---	---	---	695
172	56	6	155	24	5/79	10	---	---	---	---	696
80	36	6	20;70	10	7/66	10	0.20/10	85	215	---	697
187	32	6	160	51	5/79	10	---	---	---	---	698
60	58	6	20;55	10	7/69	10	0.50/10	---	---	---	699
112	33	6	70;100	12	5/79	25	---	---	---	---	700
100	32	6	50;90	50	8/66	10	0.50/10	---	---	---	701
67	29	6	60	---	---	40	---	---	---	---	702
155	25	6	40;90	15	10/66	5	0.04/5	239	570	---	703
155	42	6	145	24	5/79	50	---	---	---	---	704
127	21	6	60;90	17	11/78	10	---	---	---	---	705
157	20	6	140	---	---	20	---	---	---	---	706
172	21	6	120	---	---	7	---	205	520	---	707
90	21	6	---	17	5/79	25	---	239	---	---	708
125	20	6	35;115	20	7/69	10	0.33/10	120	335	---	709
187	32	6	175	49	5/79	5	---	---	---	---	710
45	17	6	20;32	8	6/66	24	2.0/24	---	---	---	711
217	21	6	120	25	5/79	3	0.11/8	17	590	---	712
105	20	6	20;90	---	---	10	0.13/10	---	---	---	713
337	66	6	170	---	---	4	---	---	---	---	714
82	21	6	40;55;65	---	---	30	---	85	290	---	715
105	21	6	100	---	---	30	---	---	---	---	716
80	---	---	75	54	11/78	---	80/8	256	625	---	717
67	21	6	50	---	---	50	---	---	---	---	718
65	23	6	60	---	---	10	---	---	---	---	719
322	65	6	150	---	---	3	---	---	---	---	720
107	---	---	---	7	11/78	---	2.5/5	---	---	---	721
125	20	6	110	---	---	10	---	---	---	---	722
300	20	6	60;125;195	10	12/74	4	0.10/4	---	---	---	723
247	21	6	135	---	---	4	---	---	---	---	724
142	20	6	120	67	5/79	10	---	274	685	---	725
217	21	6	110;180	---	---	30	---	---	---	---	726
95	21	6	60;80	---	---	15	---	---	---	---	727
200	21	6	---	---	---	6	---	---	---	---	728
127	20	6	81;110	32	5/79	30	0.54/30	---	---	---	729
67	32	6	55	17	5/79	60	2.6/60	---	---	---	730
65	10	6	35;60	25	5/79	130	3.2/130	---	---	---	731
292	55	6	280	30	6/79	15	---	274	670	---	732
85	26	6	50;65;80	---	---	30	---	---	---	---	733
185	68	6	130;170	50	8/69	10	0.08/10	---	---	---	734
112	30	6	40;70	20	8/68	8	---	291	365	---	735
127	31	6	60;100	15	7/71	12	---	222	580	---	736
247	40	6	---	31	7/79	10	---	171	460	---	737
78	20	6	70	27	8/78	50	17/50	---	---	---	738
82	45	6	70	50	12/78	15	0.75/15	---	---	---	739
352	19	6	112	65	4/78	1	0.03/1	---	---	---	740
110	21	6	80	69	6/79	6	0.30/6	---	---	---	741
80	13	6	---	40	7/79	---	2.9/7	410	1600	---	742
292	113	6	289	200	10/78	60	4.0/60	---	---	---	743
292	21	6	274	70	3/79	4	0.03/4	---	---	---	744
97	26	6	60;80	---	---	20	---	103	265	---	745
83	22	6	50;76	30	3/68	10	0.50/10	---	---	---	746
356	19	6	---	---	---	1	---	274	780	---	747
60	20	6	60	---	---	30	---	239	585	---	748
200	64	6	180	---	---	---	---	---	---	---	749
135	21	6	60;80;120	25	6/79	50	---	---	---	---	750
97	34	6	60;80	25	6/79	30	---	188	470	---	751
142	142	6	80;142	---	---	50	---	---	---	---	752
80	74	6	80	---	---	12	3.2/8	18	722	---	753
100	29	6	46;82	25	5/79	25	0.33/25	---	---	---	754
228	50	6	110;220	38	7/79	15	0.10/15	103	210	---	755
245	40	6	125;230	35	7/79	2	0.02/2	274	615	---	756
198	41	6	145;194	47	7/79	10	---	---	---	---	757
150	30	6	90;145	23	7/79	30	0.60/30	171	408	---	758
348	116	6	320;342	73	7/79	5	---	188	300	---	759
240	60	6	235	4	7/79	5	---	256	658	---	760

TABLE 13.

Well location		Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat-Long							
Fr-761	4008-7746	Don Ile	Martin W. Shatzer	1975	H	885	H	Orr/ls
762	4003-7750	M. Felmlee	Lester E. Funk	1978	H	770	S	Osp/ls
763	4008-7747	Joe Runk	R. Galen Martin	1978	H	915	S	Orr/ls
764	4003-7749	Joann Bentz	Martin W. Shatzer	1977	H	765	V	Om/sh
765	4012-7742	J. Peachey	Lester E. Funk	1978	H	940	S	Om/sh
766	4003-7749	H. Baker	Martin W. Shatzer	1978	H	742	V	Om/sh
767	4007-7747	Fannett-Metal Elementary Sch.	Harrisburg's Kohl Bros.	1973	T	860	S	Ops/dm
768	4005-7748	Leslie Barrack	Martin W. Shatzer	1977	H	760	V	Om/sh
769	4008-7746	W. Trible	do.	1974	H	815	V	Osp/ls
770	4004-7747	Stanley Kulp	do.	1974	H	835	S	Om/sh
771	4009-7745	E. Beiler	R. Galen Martin	1978	H	945	H	Ops/dm
772	4002-7751	Donald McAllen	Ralph E. Robison	1968	H	745	S	Oc/ls
773	4009-7746	M. Crouse	R. Galen Martin	1978	H	1070	S	Om/sh
774	4004-7749	Glenn Rosenbury	Eldon E. Funk	1976	H	840	S	Osp/ls
775	4011-7746	Roger Umbrell	Lester E. Funk	1977	H	1080	S	Om/sh
776	4006-7747	Tom Baker	---	1975	H	840	S	Oc/ls
777	4011-7745	Romen Kauffman	Lester E. Funk	1977	H	1015	S	Om/sh
778	4006-7746	Ray Bruck	R. Galen Martin	1977	H	780	V	Om/sh
779	4012-7744	Richard Campbell	Eldon E. Funk	1976	H	1020	W	Om/sh
780	3957-7754	W. Kell	Martin W. Shatzer	1978	H	825	S	Om/sh
781	4012-7744	Harry Gingrich	R. Galen Martin	1977	H	1015	W	Om/sh
782	3957-7755	Oren Hoff	do.	1978	H	950	W	Om/sh
783	4013-7740	Burns Valley Mennonite Ch.	do.	1976	H	1035	S	Om/sh
784	3957-7755	George Baker	Martin W. Shatzer	1977	H	975	S	Om/sh
785	4011-7743	L. Briggs	do.	1979	H	1050	S	Ops/dm
786	4000-7754	Merv Rentz	do.	1976	H	1320	S	Om/sh
787	4012-7741	Richard Miley	do.	1974	H	1175	S	Om/sh
788	4005-7748	Fred Dallmyer	do.	1976	H	775	W	Osp/ls
789	4012-7743	Robert Rosenberry	do.	1974	H	935	V	Om/sh
790	4007-7748	C. Keafer	do.	1978	H	915	S	Orr/ls
791	4009-7742	Randy Varner	R. Galen Martin	1977	H	980	W	Om/sh
792	4006-7748	Ben Neil	do.	1976	H	1035	S	Orr/ls
793	4009-7742	Michael Varner	Eldon E. Funk	1977	H	1095	S	Om/sh
794	4001-7752	T. Keefer	Martin W. Shatzer	1978	H	882	S	Osp/ls
795	4009-7741	R. Morris	R. Galen Martin	1978	H	970	S	Om/sh
796	4003-7749	Harold Park	Martin R. Shatzer	1976	H	755	S	Om/sh
797	4009-7741	R. Shoemaker	R. Galen Martin	1978	H	985	S	Om/sh
798	4011-7739	Oliver Clayton	do.	1977	H	1140	S	Om/sh
799	4011-7740	Ken Wenger	Eldon E. Funk	1976	H	1285	S	Om/sh
800	4012-7737	D. Dean	Martin W. Shatzer	1979	H	1120	W	Om/sh
801	4007-7744	John Glass	R. Galen Martin	1977	H	860	S	Om/sh
802	4010-7740	Norman Ryder	do.	1977	H	1005	S	Om/sh
803	4010-7740	Ray Cisney	do.	1977	H	1085	S	Om/sh
804	4011-7739	Nelson Clowdis	Eldon E. Funk	1976	H	1030	V	Om/sh
805	4009-7744	Dry Run Water Assoc	---	1974	P	1000	S	Om/sh
806	4014-7742	W. Tyson	R. Galen Martin	1978	H	895	S	Om/sh

(CONTINUED)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level: Depth below land surface (feet)	Static water level: Date measured (mo/yr)	Reported yield (gal/min)	Specific capacity ([gal/min]/ft)/rate (gal/min)	Hardness (mg/L)	Specific conductance (micromhos at 25°C)	pH	Well number
175	69	6	125;170	---	---	30	1.00/30	---	---	---	Fr-761
398	19	6	310;378	69	7/79	15	---	222	494	---	762
280	42	6	---	---	---	2	---	---	---	---	763
85	40	6	50;80	17	7/79	20	1.00/20	85	210	---	764
210	---	---	---	---	---	12	---	103	238	---	765
62	31	6	50	---	---	40	2.7/40	86	200	---	766
420	51	6	80;390	---	---	25	0.50/25	---	---	---	767
105	20	6	60;100	13	7/79	12	0.60/12	154	418	---	768
107	21	6	55;107	---	---	35	---	205	441	---	769
105	---	---	---	---	---	---	---	34	108	---	770
196	58	6	165	---	---	2	---	239	290	---	771
118	18	6	---	---	---	---	---	256	505	---	772
85	21	6	---	---	---	40	---	120	248	---	773
98	49	6	60;87	20	5/76	10	---	308	682	---	774
135	20	6	90;124	---	---	20	---	---	---	---	775
55	25	6	35;45	15	5/75	15	0.60/15	---	---	---	776
98	21	6	70;86	26	4/77	25	---	---	---	---	777
71	18	6	---	---	---	25	---	120	337	---	778
73	22	6	52;70	---	---	25	---	---	---	---	779
120	42	6	65;115	20	7/78	15	0.20/15	154	387	---	780
71	20	6	---	---	---	75	---	171	344	---	781
120	42	6	---	---	---	5	---	---	---	---	782
42	18	6	15;32	1	7/79	15	---	120	262	---	783
185	33	6	80;180	17	7/79	5	0.10/5	---	---	---	784
540	60	6	535	45	7/79	8	0.02/8	---	---	---	785
125	21	6	80;120	---	---	10	0.30/10	---	---	---	786
50	21	6	45	---	---	30	---	103	195	---	787
110	30	6	105	22	7/79	3	0.06/3	---	---	---	788
125	20	6	50;120;125	7	7/79	4	0.20/4	171	332	---	789
125	40	6	105	48	7/79	15	0.50/15	222	465	---	790
71	26	6	---	---	---	20	---	86	159	---	791
93	60	6	---	---	---	15	---	---	---	---	792
98	32	6	90	---	---	10	---	---	---	---	793
100	86	6	100	---	---	8	0.30/8	---	---	---	794
146	21	6	---	8	7/79	7	---	103	205	---	795
70	21	6	50;65	18	7/79	20	1.00/20	---	---	---	796
96	37	6	---	16	7/79	15	---	137	300	---	797
190	20	6	---	18	8/79	3	---	120	143	---	798
148	48	6	120;146	44	7/79	5	---	---	---	---	799
165	63	6	85;160	---	---	15	0.20/15	---	---	---	800
96	32	6	---	---	---	20	---	68	128	---	801
121	58	6	---	---	---	12	---	---	---	---	802
96	30	6	---	28	8/79	10	---	68	128	---	803
98	30	6	70;89	---	---	20	---	86	232	---	804
75	23	6	24;65	5	9/73	14	0.90/14	---	---	---	805
71	26	6	60	25	10/79	10	---	239	365	---	806

TABLE 14. RECORD OF SPRINGS

Spring number. A serial number assigned at the time the spring was first visited. Many small springs for which miscellaneous information is available are omitted from this table.

Location number: Degrees, minutes, and seconds of latitude and longitude, respectively.

Use: H, domestic, I, irrigation, N, industrial, P, public supply; U, unused.

Discharge: M, measured; E, estimated; R, reported. Estimated discharge characteristics were determined using all available estimates and measurements.

Spring no.	Location number (Latitude-longitude)	Owner (Spring name)	Altitude above sea level (feet)	Geologic unit	Discharge (gal/min)	Date measured or estimated	Estimated discharge characteristics (gal/min) Max.	Med.	Min.	Use	Temperature (°C)	Hardness (mg/L)	Specific conductance (micromhos at 25°C)	Remarks
Fr-Sp- 1	394731 774301	Greencastle Bor. (Moss Spring)	620	Rockdale Run Formation	710 560	M 7-06-44 M 11-10-71		650		P	10			
2	395412 773602	Mico Corp. (Falling Springs)	720	Elbrook Formation	1880 1680	M 7-06-44 M 11-10-71		1850		U	10			
3	395417 773558	Chester Lesher (Falling Springs)	710	Elbrook Formation	890 850	M 7-06-44 M 11-10-71		900		U	11			
4	394758 774133	(Oak Spring)	680	Stonehenge Formation	330 280	M 9-05-68 M 3-13-69		300		U	11	450		
5	395929 774039	U. S. Dept. of Defense (Rocky Spring)	620	Chambersburg Formation			2800	1600	140	U				Record of daily flow available from June 1950 to February 1951.
10	395415 775133	David Horn	800	Martinsburg Formation	25	R				U	13	340		
11	394417 773208	Rouzerville Water Co. (Hoover Spring)	700	Tomstown Formation	500	R				P				
12	395434 775416		585	Martinsburg Formation	530	E 10-13-77				U	11	120	260	Flows from basement of vacant farmhouse.
13	394743 773326	Village of Tomstown (Tomstown Pump)	770	Tomstown Formation	20	E 9-08-78				P		17	62	Location accurate to within 10 seconds of longitude and latitude.
14	400222 773528		588	St. Paul Group	620	M 10-18-78				U	12	220	660	
15	394929 773414	Paul Barkdoll	767	Waynesboro Formation	450	E 9-25-78				N	12	140	280	

16	400220	773530		588	St. Paul Group	1040	M 10-18-78	U	11.5	220	670	
17	395008	774235	Ray Gibble	600	St. Paul Group	600	E 9-27-78	U	11	270	675	Flows into sinkholes within 700 feet downstream.
18	394725	773421	John Noll (Nunnery Spring)	695	Waynesboro Formation	1190	M 10-04-78	I	13	150	340	
19	394346	773213	Abram Lecron (Lecron Spring)	690	Tomstown Formation	260	M 11-06-78	H	12	150	335	
20	395222	775605	Richard Rice	702	Pinesburg Station Formation	430	M 6-19-79		12	100	205	
21	395014	775538	Thomas Johnston	585	Chambersburg Formation	525	M 6-19-79	U	12	150	420	
22	395021	775132		510	Pinesburg Station Formation	1300	M 6-19-79	U	11.5	220	665	
23	394342	773950	(Big Spring)	600	Stoufferstown Formation	2500	M 6-22-79	U		220	625	

Om Omg

MARTINSBURG FORMATION[1]

Bulk of formation is dark gray to black, carbonaceous and fissile shale (Om) containing thin beds of fine-grained graywacke, thick medial unit of graywacke (Omg), thin basal unit of slabby, black, argillaceous limestone and calcareous shale (not mapped).

Median 1-hour specific capacities are 0.8 (gal/min)/ft for the shale and 1.4 (gal/min)/ft for [illegible] graywacke. Maximum reported yield is 150 gal/min from shale and 30 gal/min from graywacke. Calculated[2] median and maximum sustained yields are 29 gal/min and 100 [illegible] respectively, from shale and 50 gal/min and 100 gal/min from graywacke. [illegible] median sustained yield of basal limestone is 5 gal/min based on data for northern [illegible] and Valley. Water is moderately hard to very hard. Median hardness is 120 mg/L [illegible] shale and graywacke. Specific conductance of water is 310 micromhos from [illegible] 225 micromhos from graywacke. Objectionable amounts of iron and hydrogen [illegible] commonly present in water from all rock types.

Oc

CHAMBERSBURG FORMATION

Dark gray, thin- to medium-bedded limestone that characteristically weathers into cobblestone shapes.

[illegible] 1-hour specific capacity is 0.22 (gal/min)/ft. Maximum reported yield is 40 gal/min [illegible] median and maximum sustained yields are 11 gal/min and 45 gal/min respectively. Water is very hard. Median hardness is 300 mg/L, median specific conductance [illegible] micromhos.

Osp

ST. PAUL GROUP

[illegible] limestone, [illegible] dark gray, thin bedded limestone [illegible] containing black chert.

[illegible] hour specific capacity [illegible] 28 (gal/min)/ft. Maximum reported [illegible] Calculated median and maximum sustained yields are 15 gal/min and [illegible] respectively. Median hardness of water is 256 mg/L, specific conductance [illegible]

Ops

PINESBURG STATION FORMATION[3]

[illegible] medium-gray, thick bedded dolomite, some intervals of limestone. Black chert and abundant white quartz rosettes near base.

[illegible] hour specific capacity [illegible] (gal/min)/ft. Maximum reported yield [illegible] median and maximum sustained yields are 46 gal/min and [illegible] Median hardness of water is [illegible] mg/L, median specific conductance [illegible]

Orr

ROCKDALE RUN FORMATION

[illegible] light-gray limestone, contains nodules of brown chert in the east. Lower part contains [illegible] chert-bearing dolomite and banded limestone. Medium-gray limestone forms bulk of unit; some thick-bedded dolomite containing small white chert rosettes occurs near top.

[illegible] reported yield is 110 gal/min [illegible] median and maximum sustained [illegible] and 220 gal/min respectively [illegible] hardness of water is 275 mg/L [illegible] specific conductance is 620 micro-

Osh

STONEHENGE FORMATION

[illegible] gray, thin- to medium-bedded limestone, abundant algal limestone in upper half.

[illegible] reported yield [illegible] gal/min [illegible] are [illegible] gal/min and 500 gal/min [illegible] median specific conductance is 610

Ost

STOUFFERSTOWN FORMATION

[illegible] bedded [illegible] limestone containing prominent siliceous seams. [illegible] where it is mapped with Stonehenge Formation.

[illegible] area. One public supply well sustains a yield [illegible] Median hardness of water is 291 mg/L, median specific [illegible]

Csg

SHADYGROVE FORMATION

[illegible] limestone containing brown chert nodules and a few thin beds of sandstone.

[illegible] (gal/min)/ft. Maximum reported yield is 50 gal/min. [illegible] sustained yields are 68 gal/min and 210 gal/min, [illegible] of water is 274 mg/L; median specific conductance is 595

Cz

ZULLINGER FORMATION

[illegible] sequences of medium-gray, thick bedded limestone conglomerate, oolitic limestone, [illegible] terbanded limestone and dolomite, pure or silt- and sand-bearing dolomite, and a few [illegible] sandstone beds.

Median 1-hour specific capacity is 0.81 (gal/min)/ft. Maximum reported yield is 120 gal/min. Calculated median and maximum sustained yields are 43 gal/min and 390 gal/min, respectively. Median hardness of water is 274 mg/L; median specific conductance is 630 [illegible]

Ce

ELBROOK FORMATION

Massive beds of shaly limestone, calcareous shale, some algal limestone, and minor amounts of calcareous sandstone.

Median 1-hour specific capacity is 2.0 (gal/min)/ft. Maximum reported yield is 100 gal/min. Calculated median and maximum sustained yields are 45 gal/min and 250 gal/min, respectively. Median hardness of water is 239 mg/L; median specific conductance is 565 micromhos.

Cwb

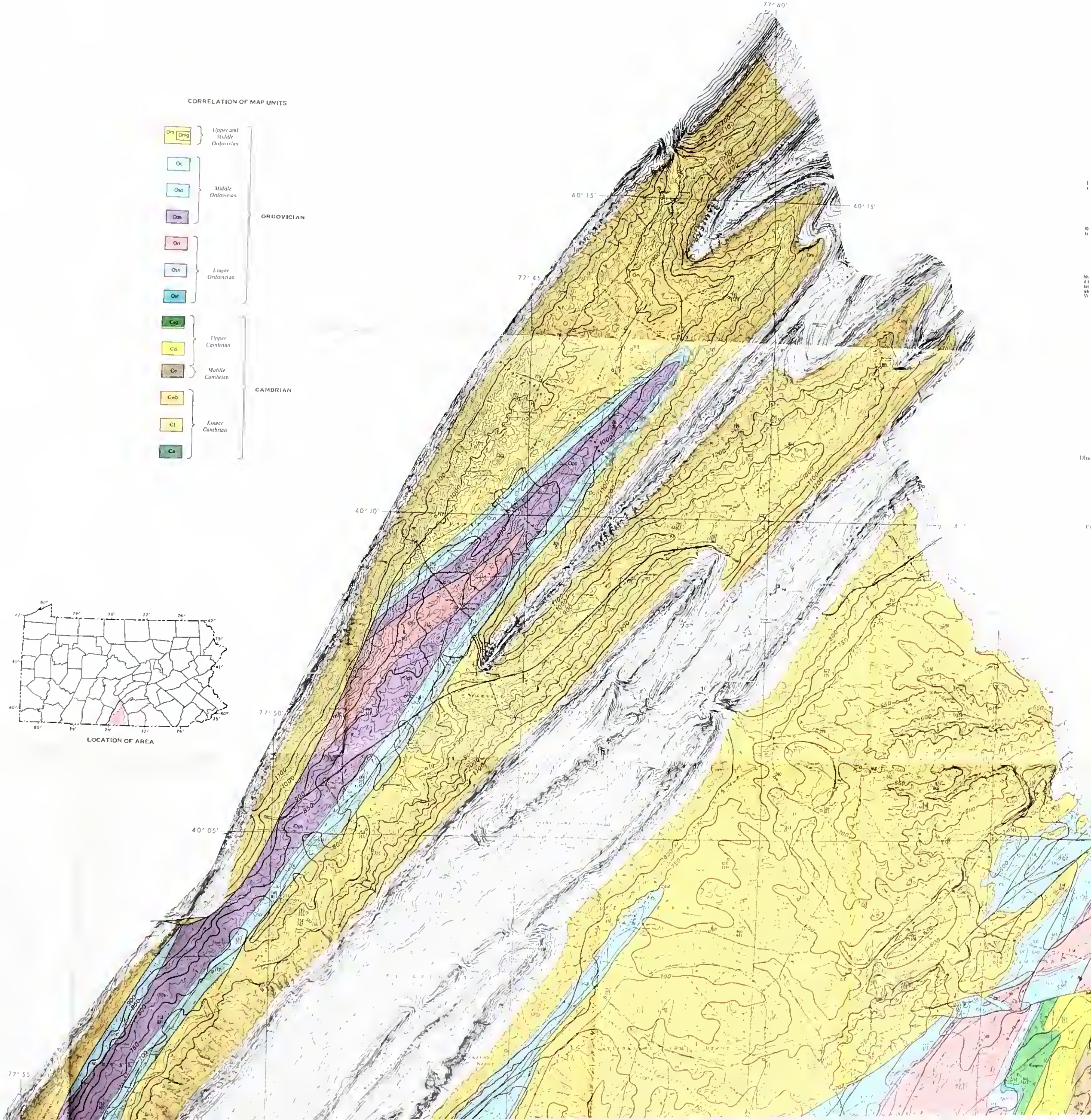
WAYNESBORO FORMATION

Poorly exposed massive, gray limestone forms bulk of unit; abundant dolomite in lower 300 feet. Upper 100 feet is red sandy shale, siltstone, and sandstone.

Median 1-hour specific capacity is 0.9 (gal/min)/ft. Maximum reported yield is 200 gal/min. Calculated median and maximum sustained yields are 42 gal/min and 260 gal/min, respectively. Water is hard. Median hardness is 137 mg/L; median specific conductance is 320 micromhos.

CORRELATION OF MAP UNITS

Map unit	Series	System
Om, Omg	*Upper and Middle Ordovician*	ORDOVICIAN
Oc	*Middle Ordovician*	ORDOVICIAN
Osp	*Middle Ordovician*	ORDOVICIAN
Ops	*Middle Ordovician*	ORDOVICIAN
Orr	*Lower Ordovician*	ORDOVICIAN
Osh	*Lower Ordovician*	ORDOVICIAN
Ost	*Lower Ordovician*	ORDOVICIAN
Csg	*Upper Cambrian*	CAMBRIAN
Cz	*Upper Cambrian*	CAMBRIAN
Ce	*Middle Cambrian*	CAMBRIAN
Cwb	*Lower Cambrian*	CAMBRIAN
Ct	*Lower Cambrian*	CAMBRIAN
Ca	*Lower Cambrian*	CAMBRIAN



LOCATION OF AREA

ELLINGER FORMATION

[illegible] thick bedded [illegible] interbanded limestone and [illegible] sandstone beds

[illegible]

Ce

ELBROOK FORMATION

Massive beds of shaly limestone, calcareous shale, some [illegible] and minor amounts of calcareous sandstone

[illegible]

Cwb

WAYNESBORO FORMATION

Poorly exposed massive, gray limestone forms bulk of unit; abundant dolomite in lower 100 feet. Upper 100 feet is red sandy shale, siltstone, and sandstone

[illegible] Water is hard. Median hardness [illegible]

Ct

TOMSTOWN FORMATION

Few exposures. Probably contains a basal part of limestone, dolomite, and interbedded shale, a middle part of dolomite, and an upper part of banded limestone and thin beds of dolomite

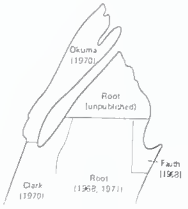
[illegible] specific capacity is 0.71 (gal/min)/ft. Maximum reported yield is 134 gal/min. Calculated median and maximum sustained yields are [illegible] and 107 gal/min respectively. Probably not tested to sufficient depths for maximum yields. Water is hard. Median hardness is 154 mg/L; median specific conductance is [illegible]

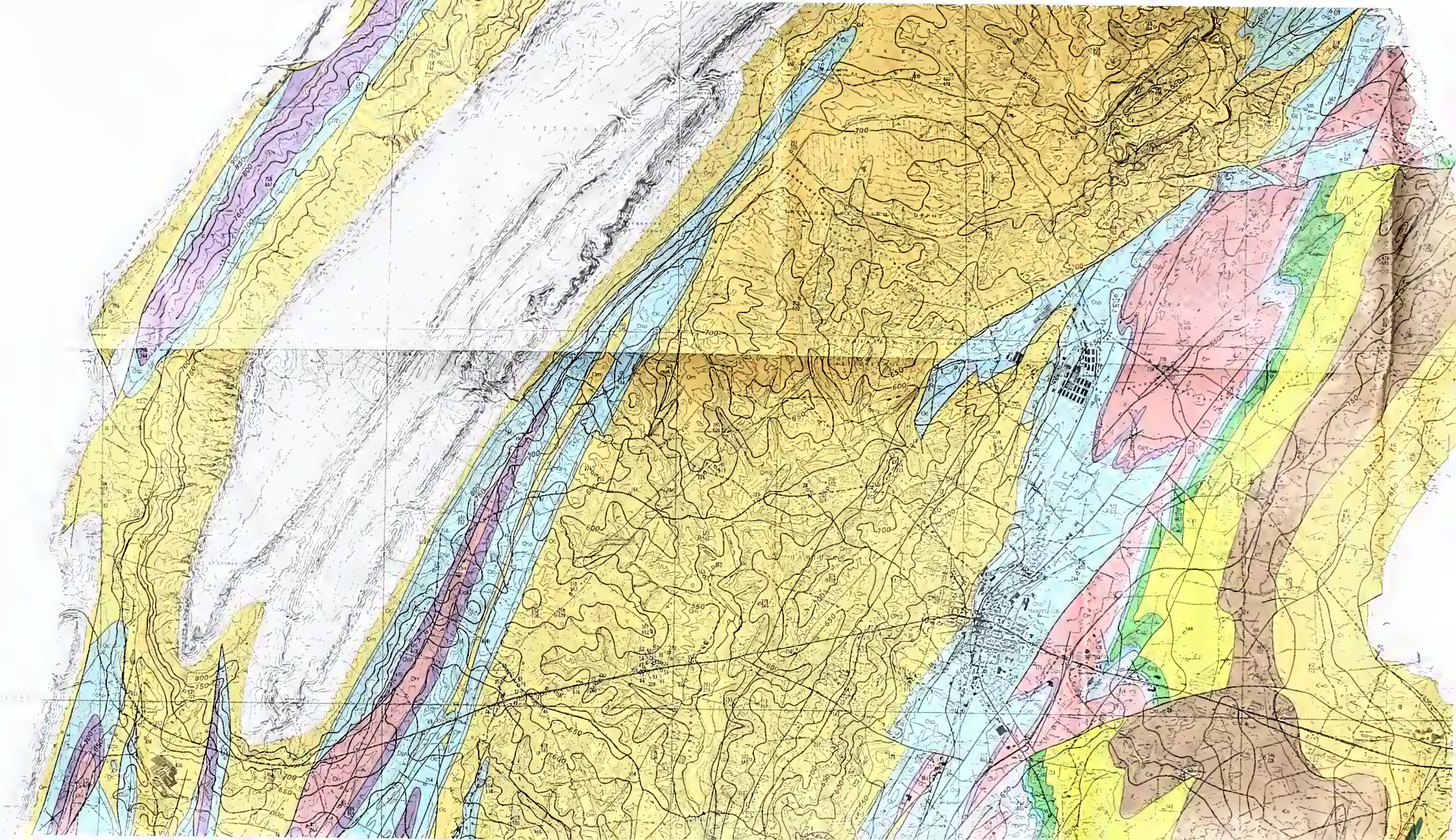
Ca

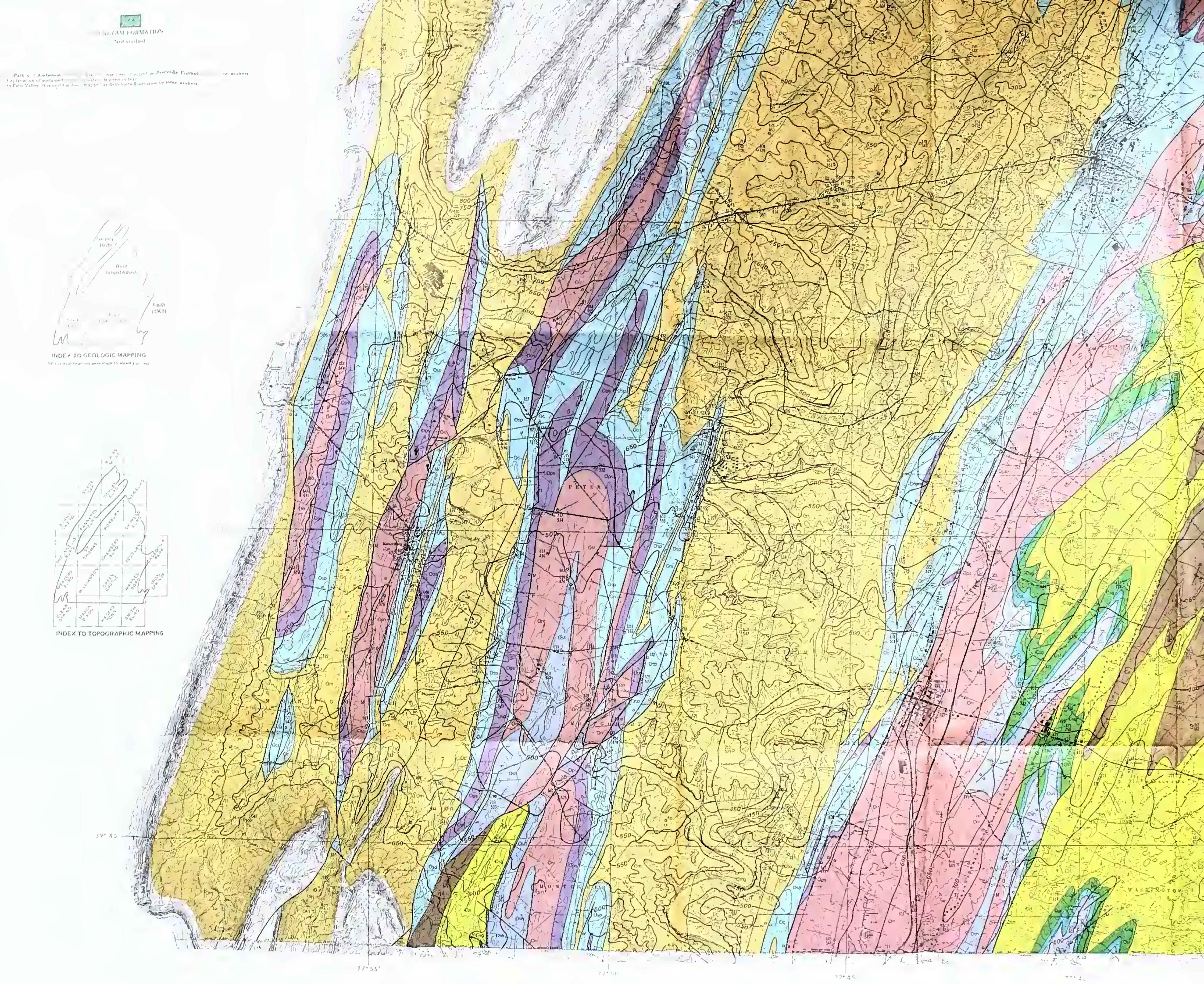
ANTIETAM FORMATION

Not studied

[1] In Path and Amberson Valleys, this unit has been mapped as Pinesville Formation by some workers
[2] Explanation of sustained yield calculation is given in text
[3] In Path Valley, this unit has been mapped as Bellefonte Formation by some workers



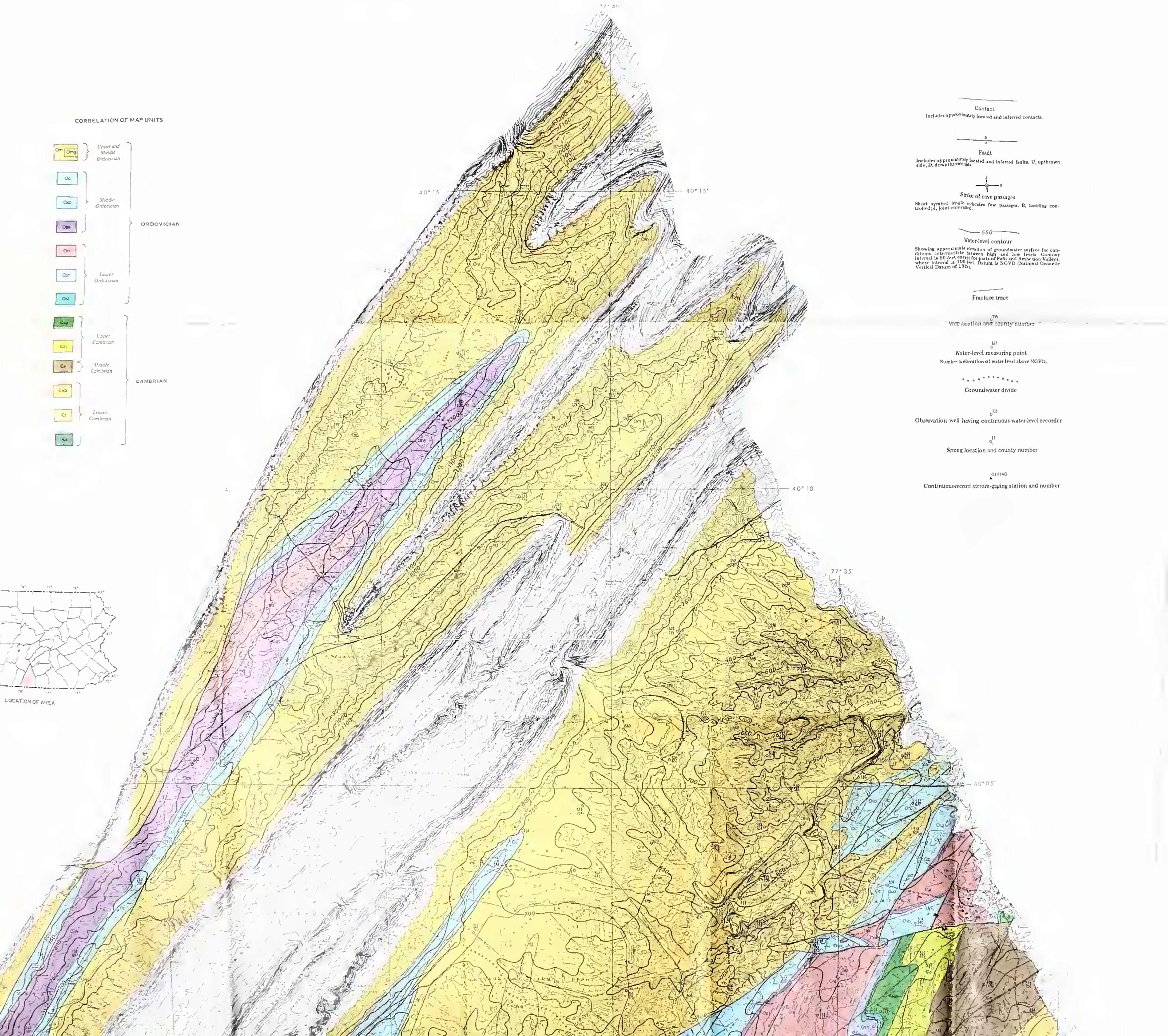




HYDROGEOLOGIC MAP OF THE CUMBERLAND AND CONTIGUOUS VALLEYS OF FRANKLIN COUNTY, PENNSY

BY ALBERT E. BECHER AND LARRY E. TAYLOR
1982

SCALE 1:50 000


CORRELATION OF MAP UNITS
Om
Omg
Upper and Middle Ordovician
Oc
Middle Ordovician
Ops
Lower Ordovician
ORDOVICIAN
Csg
Upper Cambrian
Middle Cambrian
Lower Cambrian
CAMBRIAN
LOCATION OF AREA
Contact
Includes approximately located and inferred contacts.
Fault
Includes approximately located and inferred faults. U, upthrown side, D, downthrown side
Strike of cave passages
Short symbol length indicates few passages. B, bedding controlled; J, joint controlled.
550
Water-level contour
Showing approximate elevation of groundwater surface for conditions intermediate between high and low levels. Contour interval is 50 feet except for parts of Path and Amberson Valleys, where interval is 100 feet. Datum is NGVD (National Geodetic Vertical Datum of 1929).
Fracture trace
Well location and county number
Water-level measuring point
Number is elevation of water level above NGVD.
Groundwater divide
Observation well having continuous water-level recorder
Spring location and county number
614140
Continuous-record stream-gaging station and number
77°40'
77°35'
40°15'
40°10'
40°05'

MATION
dules and a few thin beds of sandst

Maximum reported yield is 50 gal/min
s are 68 gal/min and 210 gal/min,
, median specific conductance is 595

ATION
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and sand-bearing dolomite, and a few

ft. Maximum reported yield is 120
yields are 13 gal/min and 390 gal/min
, median specific conductance is

ATION
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Maximum reported yield is 100 gal/min
ds are 15 gal/min and 250 gal/min
L, median specific conductance is 565

MATION
of unit; abundant dolomite in lower
and sandstone

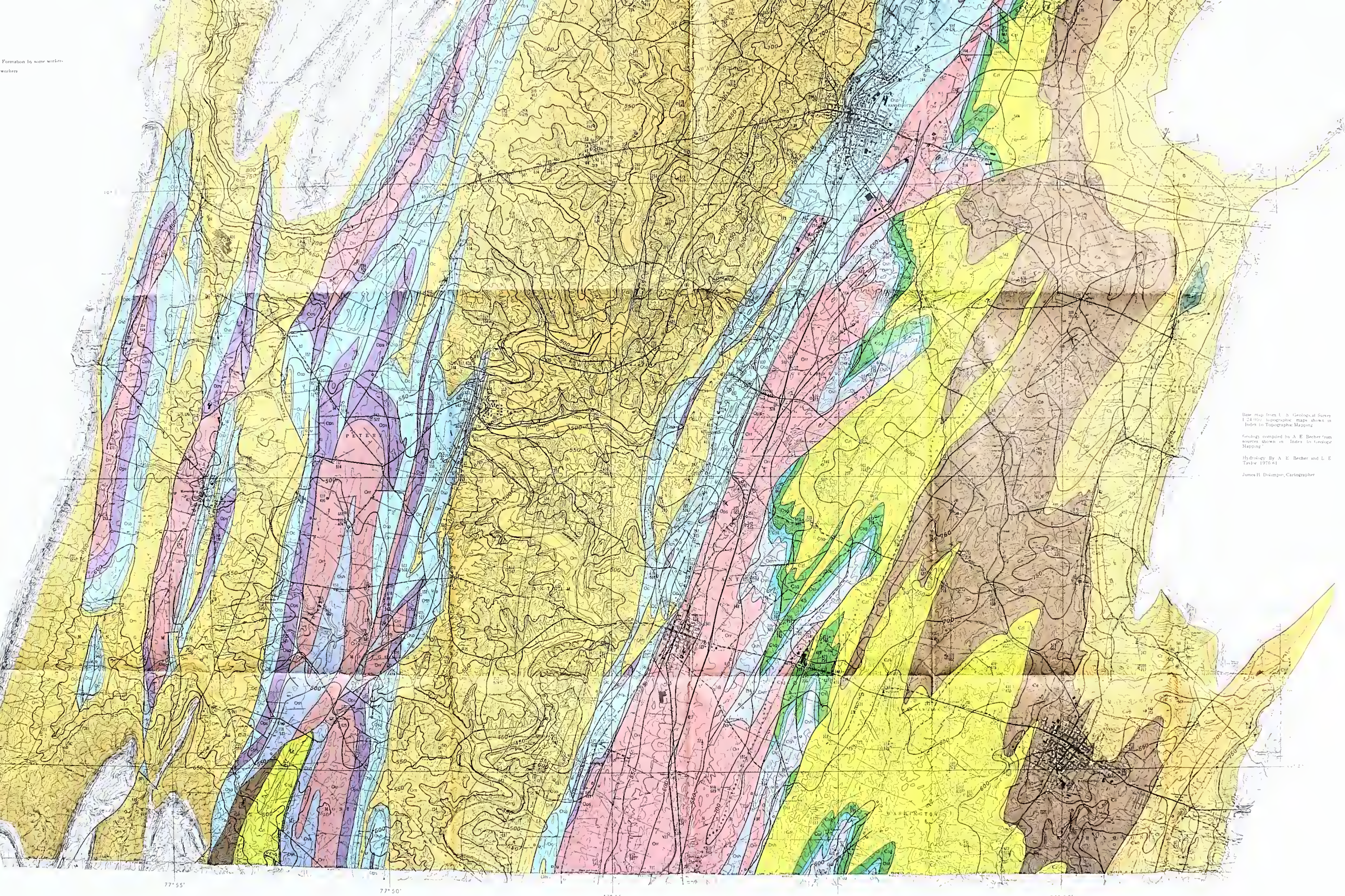
Maximum reported yield is 200 gal/min
are 12 gal/min and 260 gal/min,
7 mg/L; median specific conductance

ATION
limestone, dolomite, and interbedded
t of banded limestone and thin beds

ATION

d as Beekmantown Formation by some workers

Formation by some workers
workers



Base map from U. S. Geological Survey 1:24,000 topographic maps shown in Index to Topographic Mapping

Geology compiled by A. E. Becher from sources shown on Index to Geologic Mapping

Hydrology By A. E. Becher and L. E. Taylor 1976-81

James H. Delamater, Cartographer

HYDROGEOLOGIC MAP OF THE CUMBERLAND AND CONTIGUOUS VALLEYS OF FRANKLIN COUNTY, PENNSYLVANIA

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